

THE *Physiologia* OF
JEAN FERNEL
(1567)



Translated and Annotated by
JOHN M. FORRESTER

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The title page from Jean Fernel's *Universa Medicina*, published in 1567 in Paris by Andreas Wechel. Courtesy of the Special Collections Librarian of the University of Edinburgh. The *Physiologia* is only one component of the *Medicina*.

IO. FERNELII

A M B I A N I,

vniuersa Medicina,

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ante obitum diligenter recognita, & quatuor libris nunquam
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& in librum Therapeutices septimum doctissimis scholiis illustrata.



LVTETIÆ PARISIORVM,

APVD ANDREAM WECHELVM,

sub Pegafo, in vico Bellouaco.

I 5 6 7.

Cum priuilegio Regis ad sexennium.





THE *Physiologia* OF
JEAN FERNEL
(1567)



Translated and Annotated by
JOHN M. FORRESTER

with an Introduction by
JOHN HENRY
and
JOHN M. FORRESTER

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Figure 1. Portrait of Fernel, in his *Medicina* (1554).
This is the only known contemporary likeness.



INTRODUCTION

TRADITION AND REFORM:

Jean Fernel's *Physiologia* (1567)

Fernel's place in the History of Medicine

JEAN FERNEL (1497–1558) was one of the foremost medical writers of his day, ranked by his contemporaries and immediately succeeding generations alongside or even above Andreas Vesalius (1514–1564), famed reformer of anatomical studies, and Paracelsus (1493–1541), radical reformer of theories of disease and treatment. If Fernel is less well known today than either of these fellow reformers, it says more about the preoccupations of medical historians than it does about Fernel's historical significance. It seems fair to say that Vesalius's permanent place in the history books has been guaranteed by the importance he placed on anatomical illustration, so that his *De humani corporis fabrica* (On the fabric/construction [?] of the human body) (1543) stands out as a landmark anatomical textbook. Although the first book of Fernel's *Physiologia* is devoted to a detailed anatomical description of the human body, it was presented, as was more typical of the time, without illustrations. While anatomy was the exclusive focus of Vesalius's concerns, it was only a part of Fernel's wider endeavor and he was less concerned, therefore, to break with the traditional norms of medical publishing that relied almost exclusively upon wordy description. Given the salience of the fine arts in our own cultural hierarchy, it is hardly surprising that Vesalius and his beautifully illustrated book have commanded more attention since the eighteenth century than Fernel. Similarly, in comparison with Paracelsus, Fernel again seems far less exciting. Paracelsus so divided contemporary opinion that he rapidly became a figure of legend. The story that Paracelsus publicly burned the books of Galen and Avicenna in the town square of Basel could hardly fail to grab the attention of historians of science used to telling a story of the Scientific Revolution as a time of iconoclasm and the rejection of ancient authorities. Once again, by comparison, Fernel seemed to be a traditional writer who could safely be left out of the story of the Scientific

Revolution. This was all the more easy given the fact that Fernel did not make any significant discoveries that could be shown to have redirected the course of medical history. On the contrary, once William Harvey showed the inadequacy of the Galenic system of physiology, Fernel's life's work could all too easily be dismissed as a futile endeavor, in spite of the gallant efforts of even so distinguished a devotee as leading neurophysiologist and Nobel Prize winner (1932) Sir Charles Sherrington (1857–1952).¹

In fact, Sherrington's efforts on Fernel's behalf did indeed try to claim that he should be seen as a great innovator who deserved a place alongside Vesalius, Copernicus, Galileo, Descartes, and others precisely because, like them, he made new discoveries and contributed to the new movement toward experimental and rational medicine. Fernel's *Pathologia*, a companion to the *Physiologia* included in his compendious *Medicina* (1554), broke new ground, according to Sherrington, as a "systematic essay on morbidity, pursued unhaltingly through the body, organ by organ." This is a fair description of the latter and smaller portion of Fernel's *Pathologia* only, Books 5–7; the first portion amounts to general pathology as it might be defined even nowadays: the general considerations underlying the subject, the evidences of diseases, and the disorders involving the whole body, naturally set out in fundamentally Galenic terms. Crediting Fernel with some advance from humoral doctrine towards localization of disease, Sherrington also writes that in Fernel's time "every complaint 'from disappointed love to measles' was a disorder of the humours." But he does not venture to specify the localizations of this particular range of complaints, surely in fact a restricted range of generalized disorders! He writes too that Fernel "made necropsy, as far as he could, a routine practice for elucidating disease,"² but the detailed description of necropsy procedure at the end of Book 1 of the *Physiologia* mentions no such intention, and the *Pathologia* is virtually free of reference to necropsy. Fernel's contribution to pathology was no advance founded on the gore of numerous necropsies;³ it was simply a strikingly lucid and well-arranged statement of the then current doctrine.

Sherrington also tries to make much of Fernel's observation that the arteries dilate as the heart contracts. This "observation of some importance," which Sherrington holds to be original with Fernel, was in fact very much older, and indeed the most commonly held view at the time.⁴ Similarly, Sherrington's claim that Fernel first stated the hollow nature of the spinal cord overlooks the fact that nerves were held to be vessels for the transportation of animal spirit to all parts of the body (precisely analogous to the veins and arteries), so no anatomist at that time could have believed nerves, including the spinal column, to be anything but hollow.⁵ The peristaltic action of the esophagus, which

Sherrington sees as another of Fernel's discoveries, was described by Galen.⁶ Nor was this phenomenon forgotten for centuries after Fernel, as Sherrington supposed; Vesalius described it, too.⁷ At one point Sherrington even seeks to show how far ahead of his time Fernel was by showing that the *Physiologia* has "a foretaste of the eugenics of today."⁸

Throughout his study Sherrington also tried to emphasize Fernel's empiricist and observational approach, a hallmark of the new science of the Scientific Revolution. This was not easy for him, however. Acknowledging that "Fernel had not the experimental method," Sherrington nevertheless tried to insist that the "spirit of experiment was there."⁹ He tried to illustrate Fernel's empiricist tendencies by pointing to what he saw as Fernel's rejection of astrology and natural magic. Fernel's relinquishment of astrology was not sudden, Sherrington admitted, but rather the result of cumulative distrust brought about by increased practical experience and observation. For Sir Charles, writing in 1946, an interest in magic and the occult were inimical to the pursuit of empiricism and rational thinking. Fernel, he insisted, "had reached the conclusion that magic and astrology . . . were for their most part simply collections of loose thinking," and he had judged them "to rest upon false 'facts'—the direst element of confusion in all medicine."¹⁰ All of this is highly ironic, for historians of science in recent years have begun to uncover the strong links between the empiricism of the incipient Scientific Revolution and the natural magic tradition. Furthermore, contrary to Sherrington, Fernel has begun to emerge from this research as one of the most important figures in the history of Renaissance occultism, to rank alongside Cornelius Agrippa (1486–1535), Girolamo Cardano (1501–1576), Giambattista della Porta (1543–1615), and others. It has to be said that Sherrington's views on Fernel's attitude to astrology and magic are the least reliable aspect of his book and must be treated with extreme caution. They tell us more about attitudes toward magic held by Sherrington than they do about Fernel's attitudes. Sherrington no doubt subscribed to the positivist attitudes toward science that were typical of his age, and he could not see past them to give the historical role of magic a sympathetic hearing. Interestingly enough, Sherrington was able to draw support from Guillaume Plancy (1514–ca. 1568), Fernel's devoted follower and first biographer, who also insisted that Fernel rejected astrology. Presumably Plancy misrepresented the work of his mentor (for misrepresentation it was) for a good reason. Perhaps he was concerned about the increasing identification of Fernel with Paracelsian medicine and sought to counter it by presenting a picture of an anti-occult Fernel. But this is only speculation; more research on Plancy and his biographical account of Fernel is required.¹¹

Thanks to more sympathetic studies of Renaissance magic, it now seems clear that one of the things Fernel was trying to do in his most occult work, *De abditis rerum causis* (On the hidden causes of things, 1548), was precisely to establish empirical grounds for discriminating between what he thought of as genuine magical or occult effects, and mere superstitious claims about magical effects. So Fernel was willing to accept that amulets made of natural objects might have curative properties, but not an amulet consisting of words written on a piece of folded paper. Historians of science have recently begun to uncover the importance of the Renaissance revival of natural magic for the development of the new science and its experimental methodology. Fernel's place in this story seems assured as a result of the *De abditis rerum causis*.¹²

If there was a strong tendency among historians of science in Sherrington's day to see historical figures as precursors of modern ways of thinking, historians today prefer to try to understand the significance of those figures in their own time. Given this change of attitude, it was only a matter of time before Fernel's real significance would once again be recognized, and a number of illuminating, if rather brief, studies have now begun to appear.¹³ It is hoped that the translation presented here of one of Fernel's most important and influential works will make it easier for future scholars to locate Fernel properly at the very heart of Renaissance medicine and science.

The Importance of Fernel's *Physiologia*

Fernel's *Physiologia* is important on a number of different levels. On the one hand it can be seen as the first serious attempt to present the prevailing assumptions about the nature of the human body, which underlay the Renaissance system of medical theory, in a comprehensively synoptic way. The medical theory of Fernel's day was based mostly on the eclectic system of medicine propounded by the Hellenistic physician and philosopher Galen of Pergamum (A.D. 129–199). Galen's own accounts of the normal functioning of the human body were to be found in his *De usu partium* (On the uses of the parts) and *De naturalibus facultatibus* (On the natural faculties).¹⁴ The most usual way for these ideas to be taught to medical students, however, was through the summary and commentary on Galen provided in the *Canon* of Avicenna (980–1037).¹⁵ There was no systematic treatment of physiology until Fernel's. Accordingly, the *Physiologia* is probably the fullest and most clearly organized exposition of Renaissance Galenism that was ever written and almost immediately became a text, like those of Galen or Aristotle, upon which others

commented. It represents, therefore, the high-water mark of European Galenism. Even as Fernel was expounding the Galenic theory of the heart (see below, Book 1, Chapter 8, and Book 6, Chapters 17–18), doubts were being cast upon the reality of the pores in the interventricular septum, by which venous blood was supposed to move from the right ventricle through to the left. Vesalius's doubts, clearly expressed in the second edition of his *De fabrica* (1555), led to the affirmation of the pulmonary circulation by Realdo Columbus (ca. 1510–1559) in 1559 and to the discovery of the full circulation by William Harvey in 1628.¹⁶ The theory of the circulation signaled the end of Galenic physiology. Galen's claims that the veins, and venous blood, originated in the liver, and that this whole system was essentially separate from the arterial system, which originated from the heart, could no longer be considered tenable. Since the entire Galenic system was so carefully wrought, with everything more or less dependant upon everything else, the whole system of physiology had to be reinvestigated in the decades after the announcement of Harvey's discovery. Behind those new investigations, however, it is still possible to make out the traces left by Fernel's *Physiologia*. Such was Fernel's influence that the new anatomists and physiologists frequently used his account as the starting point from which they introduced their own innovations.¹⁷

It is surely an indication of the powerful influence of Fernel's synoptic account of the forms and functions of the parts of the healthy body that his appropriation of the word *physiologia* to describe this enterprise soon caught on.¹⁸ Previously signifying the study of nature in general, *physiologia* and its vernacular cognates rapidly came to refer exclusively to the workings of animate bodies.¹⁹ Fernel's own definition of physiology appears in the preface to his *Universa medicina* (1567): "So, if the five parts of a complete Medicine are set in order, physiology will be the first of all; it concerns itself with the nature of the wholly healthy human being, all the powers and functions."²⁰ He explains its importance in the preamble to Book 2 of the *Physiologia*:

Those who have dabbled in philosophy, the mother of all the arts, and then take up the study and handing down of medicine, think they will be doing more than enough if they rush through human anatomy and hasten forthwith to the study and treatment of individual diseases. By setting out along this shortcut, and striving towards a shallow and easy art, they fall down headlong to lurk in eternal gloom, and throwing away the light from their mind, they cover their eyes with thick darkness.²¹

Although Fernel's *Physiologia* can be seen as the apotheosis of Renaissance Galenism, it was by no means a merely conservative compendium of Galenic

ideas. Fernel wrote at a time when Aristotle, still venerated as the master of those who know, was enjoying something of a revival. It is all too easy to forget that the new availability in the Latin West of the writings of Ancient Greek philosophers, which was such a defining feature of the Renaissance, included new opportunities to read Aristotle in the original Greek. Although many scholars excitedly turned to Platonic and neo-Platonic writings, the Hermetic corpus, newly available Stoic texts, or other alternatives to Aristotle, others sought to resolve difficulties and inconsistencies in Aristotelianism by looking to the better sources of his works that now became available.²² This was especially required in the study of medicine because Galen himself sometimes drew upon Aristotelian ideas, and some of his other doctrines had been adapted in the Latin West in the light of philosophically dominant Aristotelian precepts. For a medical writer of the intellectual stature of Fernel, it was particularly important to reconsider Aristotle's works since there were a number of issues upon which Aristotle and Galen were obviously divided, and yet Truth, as everyone knew, must be indivisible. Accordingly, there are a number of points in the *Physiologia* at which Fernel directly considers Aristotle's position where it differs significantly from Galen's. Consider, for example, his examination of Aristotle's theories of semen, particularly the denial of the existence of female semen, which Fernel rejects, and the consideration of Aristotle's views on the heart as the seat of the soul, which he accepts.²³

The presence of Aristotle is by no means confined to such passages, however. It is easy to see the influence of Aristotle's way of philosophizing throughout the *Physiologia*. Fernel is always concerned that the physical system he describes should conform to the demands of logic. For example, he dismisses by means of a typically Aristotelian argument the standard assumption that the temperament of the body accounts for its heat. Since the temperament is constituted by the body's characteristic blend of the four elements, it cannot instantly change. But in cases of sudden death, the body quickly goes cold. This coldness cannot be the result of a rapid rearrangement of the four elements in the body's constitution, so the living heat must be independent of the temperament.²⁴ Similarly, like Aristotle, he is always concerned to explicate matters in terms of causes. The role of the philosopher, according to Aristotle, was to *explain* things, not merely to describe, and this entailed an exposition of causes. This is consistently Fernel's major concern throughout the *Physiologia*. Often what these concerns lead to, however, is a multiplication of explanatory devices in Fernel's physiology. Since his logic led him to dissociate vital heat from the temperament, for example, he drew upon what were chiefly neo-Platonic ideas

to explain wherein the heat resides. The vehicle of vital heat was declared to be a "most rarefied substance," an ethereal spirit. What is more, this spirit also served as the vehicle of the soul, since an incorporeal entity (the soul) could not combine with a corporeal entity (the body) without "the intervention of some suitable intermediary" (the spirit). The upshot is that "spirit is an ethereal body, the dwelling and bond of heat and of the faculties, and the key instrument for the performance of function." Fernel reasons that because it supports heat, this spirit must be of an oily nature and is consumed throughout the course of life, and yet earlier he has been at pains to insist that this vital heat is "above the nature of the elements" and that its spirit vehicle somehow "corresponds to the element of the stars." Whether the spirit is oily or starry in its nature, however, it also serves as the vehicle of the soul.²⁵ In the end it becomes difficult to know what functions of the body are to be attributed to the vital heat, what to the soul and what to their oily, ethereal vehicle.²⁶ Fernel's contemporaries did not always see the same need for such additions to the Galenic system as Fernel himself did, and it has to be said that although it is possible to understand the logic by which Fernel arrives at a multiplication of explanatory concepts, it is difficult to understand quite how he expects to draw the lines between them in practice. After all, as William Harvey was to point out, there is no evidence for the real existence of Fernel's theoretically conceived spirits.²⁷

Difficult as Fernel's views on the nature of life are to understand, one aspect is absolutely clear: their indebtedness to Platonic and neo-Platonic ideas. The *Physiologia*, therefore, provides us not only with a superb summation of the Galenic system of the body, and not only with a brilliant exemplification of the power and influence of Aristotle upon the philosophical thinking of the Renaissance period, but also with another powerful illustration of the Platonic revival in Renaissance intellectual life. It is undoubtedly a profound admiration for Platonism that leads Fernel to some of the more recondite, and idiosyncratic, aspects of his pneumatology and his theories about the nature and source of life itself. It was undoubtedly the more Platonic aspects of Fernel's system that led contemporaries to include him among the so-called neoterics, those radical innovators who, for good or ill (depending upon one's point of view), would overthrow traditional learning.²⁸

Unlike other neoterics, however, Fernel, presumably thanks to his compendious Galenism and his rational Aristotelianism, still managed to command respect from even the most conservative thinkers. Gui Patin (1601–1672), for example, Dean of the Paris Medical Faculty and a physician who serves historians well as a byword for the most hidebound conservatism, continued to

regard Fernel as one who rescued learning from decay and the calling of medicine from disaster. Patin declared Fernel to be one of his “Saints,” alongside Galen, and the best role model for his sons, even though Patin himself was a prominent member of the faction of anti-Fernelians in France, who objected to the occultism and other unorthodox aspects of Fernel’s more enthusiastic followers.²⁹ As Nancy Siraisi has recently pointed out, unlike the others dubbed neoterics, Fernel not only made a good living by his medical practice, but also maintained his position as a prominent professor of the steadfastly Galenic Paris Faculty, at least until 1556 when he was summoned to the royal court as physician to Henry II.³⁰

So herein lies Fernel’s supreme importance for the history of Renaissance medicine. He was arguably the leading expositor of the Galenic system of medicine. He exemplifies in his *Physiologia* the method and approach of a typical Aristotelian philosopher in the period immediately before the downfall of Renaissance Scholasticism. And he was regarded by his contemporaries as a leading innovator in medicine who stood far higher than a mere anatomist such as Vesalius and compared favorably with the too-subversive Paracelsus. It seems no exaggeration to say that a complete understanding of Renaissance medicine is hardly possible without a full consideration of Fernel and his achievement. If this is to be accomplished, it will require a careful reading of the *Physiologia*, arguably his most important work and the one that most clearly exemplifies the different aspects of his work—its Galenism, Aristotelianism, and neotericism. For that reason, the *Physiologia* is now offered here, in its entirety, and for the first time in English translation.

The *Physiologia* and This Translation

The transcript and translation presented here are of the final version of the *Physiologia*. A slightly different earlier version of this material appeared under the title *De naturali parte medicinae* (On the natural part of medicine) in 1542.³¹ With some amplification, especially the introduction of a new Chapter 5 into Book 5, to deal with the faculties of nutrition and secretion, this became the first part of his *Medicina* of 1554. Here the *Physiologia* was followed by parts devoted to pathology and therapeutics.³² The same material, without significant change, appeared again in his *Universa medicina* of 1567, which also included his *De abditis rerum causis*, first published in 1548.³³ The three versions and their numerous editions have not been formally collated for the purposes of this edition, but reference to both the two earlier versions has been helpful at

occasional points of uncertainty about the text, and their readings have been noted here.

The Transcript

This includes the accentuation, because on occasion the accentuation discloses which part of speech is represented by a set of letters: *hic* is not an adjective. The typography includes ligations and abbreviations of various kinds, especially tildes, and these have been expanded and not otherwise noted. In so doing, assistance in interpreting Latin abbreviations has been drawn from Ronald B. McKerrow's *Introduction to Bibliography for Literary Students* (Oxford: Clarendon Press, 1928), in which Appendix 4 supplies an extensive list and shows how Renaissance compositors would use or not use an abbreviation to facilitate justification of a line. On Greek ligations the translator was greatly assisted by Denis L. Drysdall, "Abbreviations et lettres ligaturés utilisés dans les imprimés grecs de la renaissance" (*Bibliothèque d'Humanisme et Renaissance* 51 [1989]: 393–403), which was drawn to his attention by Dr. Stephen Rawles of the University of Glasgow.

In the original, margins carry summary headings but these have not been reproduced in the transcript. Marginal references to other works have, however, been included. Account has been taken of the errata included at the end of the copy of *Universa Medicina* from which the transcript was prepared.

The Translation

Fernel has not been translated into English previously, apart from brief extracts translated by Sherrington for his *Endeavour of Jean Fernel*. The *Physiologia* was translated into French, however, in 1655, at the entreaty of "ceux qui n'entendent pas la langue Latine," and this translation was republished in 2001.³⁴ The aim here has been to produce a translation into English as readable as possible. Fernel is well able to use the inflected language of Latin in long yet lucid periods, which English cannot handle, so that syntax has to undergo substantial recasting. Though by no means verbose, Fernel very often uses pairs of near synonyms that tax a translator's patience. Undoubtedly to him, as to his contemporaries, they represent a demonstration of a well-stocked larder of words ("copia verborum"³⁵), rather than mere duplication; saying exactly the same thing in different words was a matter for contempt then as now. Erasmus thought ill of public speakers who might expound a psalm as "Create in me a clean heart, a pure heart, an unsullied heart, a spotless heart, a heart free from stain, a heart untainted by sin, a purified heart, a heart that is washed, a heart

white as snow . . . ,” and so on.³⁶ The translator (John Forrester) has not felt obliged as a matter of course to reproduce two Latin near-synonyms by two English words or to avoid repeating the same English word within a short interval if this aided clarity. Fernel, according to his biographer Plancy, took great pains in early life to acquire a sound Latin style and, like any orthodox Latin stylist of his time, avoids using the same Latin word twice in proximity: in Book 4, Chapter 7, for example, “drier” is represented by “aridius” and then eight words later by “siccus”; similarly in Book 5, Chapter 3, “numerus” and “multitudo” are interchangeable. Perhaps stylistic practices hammered out over centuries for oratory turn out unsuited to the printed word, where in case of doubt the reader can always try a second time immediately.

Three dictionaries have been of particular use. The *Oxford Latin Dictionary*’s coverage ceased some twelve centuries before Fernel, but Cicero was still a style model, hence its persisting value. Castelli’s medical dictionary is an invaluable scholarly compilation, from a rather later period than Fernel, but one still wedded to a great deal of earlier lore.³⁷ A third dictionary, Robert Stephanus’s *Dictionarium Latinogallicum* (1544), has proved very useful as an indicator of how Fernel’s contemporaries in France interpreted Latin words at the time.³⁸

In the translation, *fetus* (Fernel’s Latin word is normally “conceptus”) has been spelt thus deliberately throughout, because as lexicographers have always known, this spelling is etymologically more sound than the common British spelling “foetus.” Isidore of Seville has sometimes been blamed for initiating the deviant spelling “foetus,” but this is unfair; he used the correct spelling even if his etymology (from “foveo”) was erroneous.³⁹ It is sometimes thought that spelling once well established cannot be amended, but both of Britain’s leading medical journals have adopted the correct spelling in recent years.

On the whole, the factual anatomy of Book 1 proved least difficult to translate. But in the later books, a number of words are very difficult to translate straightforwardly because they carried extensive clouds of associations with them in Fernel’s age, and equally extensive but different clouds now. The Latin transcript is provided for those who wish to create their own understanding. Some of the difficult words are:

Temperamentum. This term for what a mixture of elements acquired that was not originally in them separately has degenerated into the mere “characteristic” of nowadays. The translator has nevertheless translated it and the associated “temperies” by “temperament” but is aware that “constitution” was favored by Sherrington; it seems reductionist. Sometimes “balance” has plausibility.

- multò iis sunt duriore, qui in oculos è secunda coniugatione protenduntur motum eis præstituri. Neque id modò ex longo viæ tractu, sed ab ipsa statim origine, quòd posteriore quam illi originem acceperint. Quocirca tam variæ huius facultatis causa non in mollitudinem aut duritiem referenda est. Quoniam igitur aliò in compositionem. Huius verò compositionis quænam est ratio? dicam paucis, differam pluribus. Cerebri corpus motu agitur assiduo, nullo tamen tangendi sensu præditum: contrà verò quæ id ipsum ambiunt meninges immobiles per se sunt, præsertim quæ crassa: tactu autem eæ valent exquisitissimo: quæ singula vt Galeni fide confirmata sunt, ita etiam vulnerata aperta que calua contrectantibus nobis sunt deprehensa.
- 10 Hæc autem morborum euentus plenius declarant, quòd in delirio & phrenitide (quæ ipsa phlegmonè est substantiæ cerebri) nullus plerunque dolor affligit, multoque minus in sopore & lethargo, qui tamen cum putredine est: at si vel minima occasio aut humoris aut etiam vaporis acrioris in meninges effertur, grauis dolor excruciat: quæ cerebri & meningum diuersam naturam commostrant. Atqui spina & nervi omnes vel eo auctore medullam habent è cerebro, eamque meningibus conuestitam, quæ singula talem vim & naturam habent, qualem ab exortu acceperunt. Quocirca necesse est medullam in spina atque nervis (tamen si ea non vt cerebrum motu agitur) vim duntaxat mouentem, eius verò membranas vim sentientem & tractabilem tum suscipere, tum aliis particulis conferre. Si enim corpus cerebri sensus est expers, multò magis quæ in spina aut nervis est medulla. Vnde enim & qua conditione vim nouam accepisset? Aut quomodo cerebri corpus vim illi sentientem conferat, quam non habet? Itaque quicumque nervi & tangendi & mouendi vim obtinent, vtriusque functionis instrumenta sunt, parte tamen diuersa. Qui sentientes dicuntur, solius tactus, nullius autem motus authores sunt, quod genus ij sunt qui è sexta coniugatione in interiora viscera & in extimam cutem abeunt. Hi quamquam non à solis meningibus (vt nonnulli quondam censuerunt) producantur, ab eis tamen substantiæ suæ plurimum receperunt, à cerebro minimum: statim enim à tenui meninge orti vt ad crassiorè appulerunt, multum incrementi, roboris & virium illinc acciscunt sibi. Quapropter tactum duntaxat, non item motum efficiunt. Contrà
- 30 verò qui ex spina orti magnam cernuntur medullæ copiam suo exortu continere. Ergo prior cerebri pars sensus, posterior verò motus principii est atque sedes, meninges autem tactus sunt origo: omnium autem animalium functionum efficiens est cerebrum suis meningibus conuestitum. Qui nervi multa medulla conferti sunt, mouendi instrumenta existunt, tangendi autem ij quos maiore ex parte meninges protulerunt. Hoc si exquisitiùs pronuntiandum est, motus voluntarij proprii organum est musculus: qui quum ex simplici carne, ex vena, arteria, atque nervo còditus sit, ex nervo tamen qui inter cætera principatum habet, cuique præcipua mouendi functio refertur accepta, vim omnè assumit. Hic in musculi principium, quod caput appellant, inferitur primum in paucas portiones distributus, sed quæ rursum in alias
- 40 tandè in fibras prætenues diffundantur. Omnes rursum in musculi sine coëunt, vbi neruum parem atque principio referunt, qui aut in tendonem aut in os aut in membranam intruditur. His ita de instrumentorum ratione constitutis, promptum fuerit vulnera quæcunque paulò antè infligebantur eadem per sanare. Itaque si mouendi facultas eandem cum sentiente substantiam est sortita, neque hæc disiunctæ sunt animæ partes, cur non omnia quæ sentiunt animantia vt rerum comprehensionem quandam & appetitum habent, sic etiam progrediendi vim sunt assequuta? Quia (inquam) motus instrumenta non acceperunt, quibus deficientibus necesse est & functiones & earum facultates deesse. Quanquam igitur tactu omnia prædita sunt animantia, quòd vnus ad salutem & conseruationem maximè sit necessarius, eoque dempro animal effugere non possit tractabilium qualitarum exuperantias, quarum occurru mors statim irruit: reliquis tamen sensibus qui boni cuiusdam & locupletioris notæ, non necessitatis gratiâ conditi sunt, non omnia instruuntur animalia: imò verò ab eisdem homo quadoque tum ortus tum morbi vitio deferitur, quum ab idoneis instrumentis destituatur. Alia animantia solo tactu vigent, cui alia gustum,

Alio m-
nentiū, aliā
sentientium
esse compo-
sitionem.
Cerebrū mo-
nenti, menin-
ges sentire.

Vim mouen-
di esse à cere-
bro, vim sen-
tiendi à men-
tingibus.

Cerebrū
motus ex
sensu prin-
cipium, ex
quomodo.

Mouendi in-
strumentum
propriū.

Argumen-
torum solu-
tio.

Figure 2. Specimen page of the edition of Fernel's *Physiologia* from which the present transcript is derived.

“Complexion” has sound justification as an orthodox contemporary rendering of the Greek “crasis” and an equivalent to “temperamentum,” and appeals to the distinguished historian of medicine, Nancy Siraisi.⁴⁰

Patibilis and similar words depend on the antithesis between doing something and having something done to one. “Passive” and especially “impassive” have by the twenty-first century lost this neutral background, once commonplace to everyone who used Latin as the language of scientific discourse, and carry emotional nuances that have constrained the translator to a variety of expedients with which the reader will, he hopes, sympathize. *Species* and *forma*. The translation treats these as synonymous, since Fernel seems to do so, and keeps “form” for them to retain the orthodox “realist” associations as far as possible. *Genus* has a clear-cut taxonomic association now, but not to Fernel; “kind” has been kept as the only obvious alternative to repeating the Latin word with inverted commas around it.

In both text and translation, [P2], for instance, indicates the top of the original folio page 2 in the 1567 edition transcribed in the present work.

THE *Physiologia* OF
JEAN FERNEL
(1567)





DE PARTIUM CORPORIS HUMANI DESCRIPTIONE. LIBER PRIMUS.

*Quo doctrinae atque demonstrationis ordine ars medica
constituenda sit. Cap. I.*

[PI] CUM LIBER solutúsque est animus, nudas et apertas rerum substantias perspicuè cernens, clarissima omnium cognitione fruitur: in hoc verò corporis velut ergastulum coniectus, obrutúsque obliuione tanquam densa caligine, in summa versatur ignoratione rerum. At nihilominus semina quaedam etiamnum retinens diuinitatis suae, rerúmque maximarum dulci recordatione quasi igniculis accensus, perpetuo sciendi noscendíque desiderio flagrat. Hinc magno cum labore et studio multa recuperat perscrutatúrque sensuum ope, atque in ea primùm incumbens, quae sensibus sunt obuia, occultiora tandem ratione colligit sola mente comprehensa. Ita quidem à sensibus tanquam à certis rerum internunciis stabilita olim fuerunt disciplinarum principia, è quibus demum perfecta omnis humana cognitio ducta deriuatáque est. Haec summa est inuestigandi facultas, quam probatissimi quique Philosophi Ἀνάλυσιν, id est dissolutionem appellarunt: quae nimirum vel à toto et vniuerso ad partes et singula, vel à composito ad simplicia, vel ab effectu ad causam, vel à posterioribus ad priora serie deducens, abditiore illas causas inuestigat, ex quibus singula ortu processerunt. Huic aduersa est altera componendi ratio, quam maximè natura nonnunquam et ars ipsa sequitur, ex partibus ea totum, ex simplicibus compositum, ex causis effectus, ex prioribus posteriora nectit, atque id omnium primum statuit, quod dissoluendo postremum fuit peruestigatum. Doctrinae suae philosophi initium ab analysi duxerunt, quibus curae fuit omnia dilucidè atque certo demonstrationis nexu confirmare. Sic Geometriam et Arithmeticen Euclides, sic Astronomiam Ptolemaeus, sic et Philosophiam

Hippoc. Libelli
de praeceptis
statim initio.



BOOK 1

DESCRIPTION OF THE PARTS OF THE HUMAN BODY

Chapter I. The order of teaching and demonstration in
which the art of medicine should be arranged.

[P1] WHEN THE mind is free and untrammelled, and clearly perceives the uncovered and unveiled essences of things, it possesses the most lucid acquaintance with everything: but when forced into this prisonlike body, it is overwhelmed by a thick cloud of forgetfulness, and becomes totally ignorant of reality. Yet it still clings to some seeds of its divine nature, and is fired by fragrant recollection of very great matters; it is inflamed with perpetual longing to discover and know. Consequently, with considerable zeal and energy it uses its senses to regain and scan a great deal, and by concentrating initially on what comes readily before the senses, gathers in the end through reasoning the more hidden matters that are grasped by the mind alone. Thus the senses have been established as reliable informants about reality, for the establishment of the first principles of the branches of study; from these principles all perfect human knowledge has come to be drawn. The supreme faculty of inquiry is what all the most respected Philosophers called Analysis; it can carry the argument from the whole or universal to the parts or single items; from the composite to the simple; from the effects to the cause; from what is later in sequence to what is earlier. It inquires into those more deeply hidden causes from which individual things initially developed. Contrasted with this is the other way of contriving things, which nature particularly follows, and sometimes art too: it links the whole to the parts, the complex to the simple, the effects to their causes, the later to the earlier, and it makes its first concern what the analytic approach considered last. The philosophers who have made analysis the starting point of their teaching have been those who sought to link everything together clearly and by a reliable chain of proof. Thus Euclid set down for posterity his geometry and arithmetic, Ptolemy his astronomy, and Aristotle his philosophy;

Aristoteles posteris tradidit, eaque solida doctrinae suae fundamenta iecit, è quibus multa tandem producerentur incredibilia vulgò et monstri vel portentì simillima.¹ Hos igitur quasi vestigiis odorati tradendae medicinae initium ab humano corpore ducemus, quod et artis subiectum existit, et omnium primum sensibus occurrit notissimum: à quo dein per minima quaeque deducti ad ea denique mentis impulsu feremur, quae cogitatione sola comprehendi possunt.

Quid hominis corpus à caeteris distat animantibus, quasque partes habet cum illis communes. Cap. II.

[P2] At vniuscuiusque animantis, ita maximè hominis corpus animae gratia conditum est, non modò vt diuersorium, verùm etiam vt organum accommodatum illius insitis viribus expromendis. Atque vt mens, dicente Aristotele, formarum est praestantissima, et ratio artium omnium ars vel officina, quòd vna omnes omnium animantium vires potestate contineat: ita et illius organum instructissimum est, et conformationem pulcherrimam consequutum. Itaque homini corpus datum est, tum figura tum partium commoditate princeps: quod vt diuinae mentis munere fungeretur, tria obtinuit quae caeteris animantibus negauit rerum natura. Primum quidem figuram celsam et rectam, quae in coelum suumque conditorem se attolens [*sic*], coelestes igniculos et semina diuinitatis suae testatur.² Deinde summo corpore cerebrum amplissimum, animi eiusque partium sedem: vt enim animus permultis facultatibus praeditus est, ita homini quàm caeteris animantibus domicilium capacius dari par erat, idque pluribus instrumentis contineri. Praeterea manus exporrectas beluis denegatas, quibus facilè persequatur quaecunque mens iusserit. Licet quidem et clauēs soli homini datas,³ et alia multa multò aliter atque caeteris animantibus informata numerare, sed quae tamen sint illorum trium vsibus accommodata: vt sit partium omnium summa symmetria, ex cuius praestantia signum quoddam et specimen sapientis conditoris ostenditur. Haec igitur homini quòd rationis esset particeps, sunt attributa. Caetera obtinet cum aliis quoque animantibus perfectis communia. Nam cùm summa omnium actio in sensu ac motu consistat, omnia [all creatures] peraequè partes in haec accommodatas acceperunt, ossa, cartilagine, vincula, neruos, musculos, tendones:⁴ et alias quibus hae aluntur maximèque venas et arterias. Sensus atque motus primae partes effectrices sunt, cerebrum, spinae medulla, atque nerui. A cerebro

Aristotle laid those firm foundations of his teaching, from which later much could be developed that was incredible to ordinary people, and monstrous or portentous. Following the scent of these [authorities], we will make the human body the starting point of medical doctrine, both because it is the basis of the art, and because it comes very obviously to the notice of the senses right at the start. From it we shall be drawn along by very small steps at the prompting of the mind, to the matters that can only be grasped by thought.

Chapter 2. The difference between the human body and those of the other animals, and the parts that both share.

[P2] THE BODY of each living thing, and especially the human body, is constructed for the sake of the soul, not just as its lodging, but also as the instrument suited to display its resident powers. The mind, as Aristotle put it, is the most excellent of forms, and reason is the skill of all skills, or their workshop, since it binds in one potentiality the powers of all living things. Similarly, its organ is very well furnished, and possesses a very beautiful shape. Thus man has been given a body notable both for its shape and for the appropriateness of its parts: to enable it to perform the work of the divine mind, it possessed three things that Nature has denied to the rest of living things. The first is a lofty and upright posture, which in raising itself towards heaven and its creator bears witness to the heavenly sparks and seeds of its divinity. Then at the top of the body is the extensive brain, the seat of the mind and its parts: the mind being endowed with numerous faculties, man has rightly been provided with a larger accommodation for it than the other creatures possess, and this accommodation is associated with more instruments. Especially a thing denied to the beasts: hands that are stretched out, enabling man to pursue easily whatever his mind has demanded.¹ One can reckon the collarbones that man alone has been given, and many other features differentiating him considerably from the other creatures, but that are to be suited to the uses of those three.² This is to bring about the utmost symmetry of all the parts, a symmetry so striking as to exhibit a sign and token of the wise creator. These have been bestowed on man because he had his share of reasoning power. He has other points in common with the other perfect creatures. For since the highest performance of all [creatures] comprises sensation and movement, they all alike have acquired the parts needed for this: bones, cartilages, ligaments, nerves, muscles, tendons; and other parts that nourish these, particularly the veins and arteries. The main parts that bring about sensation and motion are the brain, spinal marrow, and nerves. All motion and sensation proceeds from the brain,

omnis motus atque sensus, à quo medulla in omnem spinam fusa porrigitur: ab hac demum neruorum frequens propago, per quos vniuersum corpus mouendi sentiendique vires accipit. Cùm verò minimè tutum esset nec decorum, vermiculorum serpentiũque more repere hominem tot rerum principem, firmis ossibus illi natura corpus erexit atque stabiliuit: vt tamquam propugnacula essent aduersus omnes impetus, et stabilimen atque robur corpori sustinendo, haud secus atque basis et columna aedibus subiecta. Caeterum non in animante (nec enim commodum atque vtile fuerat) os vnicum idque solidum positum est, sed quò in omnem partem flecti mouerique posset, ex variis discretisque compactum. Vtque elegantiore artificio naturae hoc opus constaret, idcirco articulis ita iuncta et continuata sunt ossa, vt cuiusque extremitas alterius sinum et capacitatem subeat. Ea structura Graecis est ἄρθρωσις, ossium extrema sic apte composita, articulos appellamus. Quoniam verò periculum erat ne motu violento ossa seiugata distraherentur, néue dum artus animal quocunque vult inflectit, contorquet, porrigit, aut contrahit, ex sedibus exciderent, natura omnem ossium copulationem et structuram arctissimis firmissimisque vinculis extrinsecus rotundo ambitu colligauit, quae articulos non sinant motus agitatione diuelli. Validum quidem est vinculum, durum atque firmum, sensu vacans et impatibile, sed quod tamen in angustum adduci possit et relaxari. Addidit et articulis [*sic*; corrected to articulis in the Errata at end of the volume] munitionem, dum ossium sinus et summas partes, quae supercilia à quibusdam vocantur, omnia denique extrema cartilaginibus obduxit obliniuitque; lubrica laeuique materia, quò sint in motibus ab attritu, et quassu tutiores. Iisdem quoque auriculas, nares, extremasque costas muniuit, vt duriorum corporum occursui cederent, et infracta permanerent. Quemadmodum autem articuli et quae dicuntur cartilagineae, sic et vincula expertia sunt sensus, quae nil mutantur à cerebro, qua de causa ne se ipsa quidem mouere possunt. At verò neruis quorum è cerebro aut è spinae medulla est origo, prima sentiendi mouendique facultas data, qui tamen quoniam molles sunt, soli transferre nequeunt ossa, tam magna pondera. Vt haec igitur mouerentur, necesse fuit motus instrumentum quoddam creari [P₃] ex ambobus temperatum, neruo solidius et durius, vinculo mollius, quod in sensu et robore mediam inter illa naturam obtineret. Id quidem est τένων [τένωμ in 1554], qui coepit à nostris tendo appellari, ex tenuibus nerui et vinculi fibris intextis concretus. Tenuia quasi fila tutum non erat sine firmamento in omne corpus distribui, ossaque praegrandia mouere: quocirca natura medias inter illa regiones molliore substantia inferciens, quasi rimas expleuit. Ea est caro simplex fibris ad robur circuniecta, ac veluti molle stragulum data cadenti aut recumbenti animali, vtque praesidium quoddam omnibus particulis principibus obtenta,

from which the spinal marrow extends into all of the spine. Ultimately, nerves sprout from the marrow at close intervals, and through them the whole body receives the powers of movement and sensation. Since it would be hardly safe or seemly for man, who is master of so much, to crawl along like the worms or snakes, nature has set his body upright and made it steady with strong bones, to serve as bulwarks against all assaults, and a stout steadying feature for the body's support, resembling the base and pillar that support a house. But in a living thing there is not [just] a single sturdy bone, an arrangement neither convenient nor serviceable; instead, its bone is built from various separate items, so that it could bend and move in every direction. To make this a piece of Nature's more refined workmanship, the bones are linked and connected by joints in such a way that the end of each enters into the hollow and cavity of another. In Greek this structure is an "arthrosis"; we call the ends of bones thus neatly fitted together "joints." Since there was a chance that bones separated by a violent movement might be pulled apart, or leave their seats while the animal bends, twists, extends or withdraws its joints wherever it desires, nature bonded every link and assembly of the bones with extremely close and tight ligaments surrounding them externally; these prevent joints being torn apart by violent movement. A ligament is strong, hard, and firm, without sensation and feeling, but can be tightened and loosened. Nature provided extra protection for the joints, by covering over and masking the hollows and prominences (called "brows" by some) and all the ends with cartilages: slippery and smooth material, which protects them from wear due to movements and shaking. Nature also provided the ears, the nose, and the ends of the ribs with cartilages, so that they yielded and remained unbroken when harder bodies struck them. Like joints and what are called cartilages, ligaments too lack sensation, having no share of it from the brain, and consequently cannot move even themselves. But the nerves that start from the brain or the spinal marrow have been given the key faculty of feeling and moving; however, being soft, they cannot on their own shift such heavy weights as bones. [P3] To enable the bones to be moved, some instrument of motion had to be created, intermediate between the two: harder and more compact than nerve, softer than ligament, to be naturally between them in feeling and strength. This is in Greek *tenon*, which is beginning in our circle to be called *tendon*, and is hardened with fine fibers of nerve and ligament interwoven. Since it was unsafe without any support to have throughout the body what are virtually fine threads moving very substantial bones, Nature inserted softer material into the gaps between them, as it were to fill up the cracks. This material is simple flesh inserted around the fibers for strength, providing a kind of soft mattress for an animal that falls or is lying down, as well

ne aut vulnerentur, aut frigore rigeant, aut aestu contabescant. Quod igitur ex nervi et vinculi fibris duntaxat contextitur, tendonem dicimus, qui verò praeterea carnem habent fibris inductam et impositam, musculi appellantur et lacerti, hi plerunque in tendonem desinunt. Nunc autem si omnia conferre volumus, quae ad motionem vim quandam et locum obtinent, ossa primùm et maximè impelluntur cientúrque: quae illis motum afferunt instrumenta, sunt tendones, lacerti, nervi duriores praesertim: mouendi principium, cerebrum et spinae medulla: partes quarum beneficio mouetur animal, articuli, cartilagines, vincula: hac igitur partium commoditate motum fieri congruebat. At in sensu longè impar et dissimilis est ratio. Cùm enim motio actio quaedam sit, sensus verò perpersio verius quàm actio: haudquaquam sensus eum apparatus ornatúmque partium, quem motus desiderabat. Nam tactionis sensus quem omnes [*sic*] ex aequo animantes participant, nervis neruorúmque fibris in omne corpus diffusis indigebat: quibus susceptae tractabiles qualitates cum spinae medulla et cerebro, quae (ut aliquando demonstrabimus) sensus et motus principia sunt, continuatione communicantur. Caeteri autem sensus quibus animantes perfectiores sunt praeditae, nervis item constant, per quos sensum capiant.⁵ Partes in singulis instrumentis circumiectae nervis, horum duntaxat gratia consistunt. Ex quibus perspicuum sit, homini quàm animal est, cerebrum, spinae medullam, nervos, et caeteras quas connumeraui partes ad motum aut sensum concurrere: de quibus rursum sigillatim dicemus, ab iis exorsi quae caeteris quasi fundamenta iaciuntur. Etenim hominem arte descripturi, σκελετὸν, id est aridum et osseum primùm extruemus, quem deinde vinculis, nervis, lacertis, venis, arteriis, cute, reliquis denique partibus interioribus adornatum, perpolitúmque reddemus. Sic ex simplicibus hominis partibus vniuersi compositionem perspiciet qui volet, et luculentius quàm si confectionis ordine compositiores partes seorsim scrutetur. Harum siquidem inspectione, nihil certum sciri, nihil planè cognosci ac percipi potest earum, quae simplices in omne corpus feruntur.

De ossibus. Cap. III.

Omnium ossium sedes et origo spina est, quam veteres carinae in nauigio primum iactae compararunt: cui ceu fundamento latera, prora, puppis innixa cohaerent.

as a protection for all the important parts against injury or stiffening from cold or wasting away with heat. So we call the product woven simply from fibers of nerve and ligament, a tendon; tendons that have in addition flesh drawn over and placed on their fibers are called muscles,³ and generally end as a tendon. Now if we wish to make a comparison of everything that possesses some power and influence for movement, first and chiefly it is the bones that are set in motion and impelled; the instruments that convey movement to them are particularly the tendons, the muscles, the harder nerves; the origin of the movement is the brain and the spinal medulla; the parts thanks to which the animal moves are the joints, cartilages, and ligaments; thus it was appropriate that movement should take place through this fitness of the parts.

But the basis of sensation is entirely distinct and different. While a movement is a type of action, a sensation is more precisely an experience than an action, and does not require at all the machinery and array of parts that a movement did. The sense of touch that all living things equally share needed the nerves and nerve fibers that extend through all the body; sustained by these, the manipulable ["tractables"] qualities are linked in succession with the spinal medulla and the brain, the origins (as one day I shall demonstrate) of sensation and movement. The other senses possessed by the more perfect animals also depend on nerves, through which sensation is received. In individual instruments, the parts surrounding the nerves exist simply for their sake. Thus it is clear that for man as an animal, the brain, spinal medulla, nerves, and the other parts I have included play their part in movement and sensation. We shall speak of them one by one later, starting from those that are established as in a way the basis of the others. In setting about a competent description of a man, we shall first construct the skeleton, the dry bony thing that we shall go on to furnish and finish off with ligaments, nerves, muscles, veins, arteries, skin, and the rest of the internal parts. Thus anyone who wishes will observe the assembling of the whole out of the simple components of a man, even more clearly than if he studied separately more elaborate parts in the order of their completion, since through looking at these neither reliable knowledge nor a complete grasp and understanding is to be had of the simple components that enter into every body.

Chapter 3. The bones.

THE BASE and starting point of all the bones is the spine, which the ancients compared to the keel, the first part of a ship to be laid down. On it as foundation the sides, the prow, and the poop rest to hold them together. Just as

Atque vt hac clitellarij muli perferunt grauissima pondera, ita in homine corporis moles huius ope stat et erigitur. Ad necessitatem actionum cū hominem flecti curuarique oporteret, pluribus coagmentata et compacta est ossibus tanquam nodis, quae vertebrae nobis dicuntur, omnes osse sacro suffultae. Vniuersa siquidem spina quatuor in partes fusa exporrectaque est, os sacrum, lumbos, dorsum, et collum. Os sacrum quod et latum appellant, primo aspectu vnum atque continuum videtur, at aqua vel oleo feruenti diu multūque demersum, sex⁶ quasi vertebriis constare. Cuius ab ima parte os aliud appensum demittitur, quod Graecis κόκκυξ, nostris cauda dici possit: hoc quoque compactum quatuor ossibus teretibus, gracilibus, et magna ex parte cartilaginosi. Supra os sacrum lumbus quinque ossibus consedit, cui dorsum insident vertebriis structum duodecim, proximè ceruix septem. Itaque triginta sunt omnes in spina vertebrae. Omnium os sacrum est amplissimum, cui tum magnitudine tum crassitudine succedunt lumborum vertebrae, arcto cauo mediae perfossae. Reliquae superiores quantum situ ab infima, tantundem et mole distant: vt sit illarum ad occipitis radices continuata [P4] quaedam attenuatio. Caeterum quae in summis inest interior capacitas, medullae labenti peruia, omnium est amplissima, inde verò tantum coarctatur, quantum dilapsa processit. Vt semel dicam, superiores vertebrae interceptis inanitatibus amplae sunt, mole graciles, contrà inferiores, omnes mira compage ad δυσπάθειαν contextae: atque vt his structura foret tutior, figuram variam acceperunt. Quà quidem intrò ad intestina vergunt, rotundae sunt et in orbem conuolutae, laeues, nullis tuberibus exasperatae, sed vt nodi (hinc σπόνδυλοι nomen inuenerunt) aliis alijs superpositi columnam exprimunt: quibus est substantia tenera magis et rara, ac spatiis inanibus intercepta. Extrà multiplices efferuntur productiones (ἀποφύσεις appellantur a Graecis) densiore illae et compactiore substantia, à quibus externa facies spinae speciem refert. Alij enim processus sunt è medio prominentes, alijs transuersi vtrinque additi, alijs sursum deorsumque ducti, per quos vertebrae texuntur et cohaerent. Supremis duabus exceptis, habet caeterarum vnaquaeque inferiore ex parte mediocres vtrinque ramos deorsum spectantes: ex superiore verò alios maiores extumescences sursum exigit. Talis autem est vertebrarum contextus, vt processus sursum euecti, modicos sinus habeant, qui alios quoque processus a superiore vertebra delapsos excipiant: sex inferioribus vertebriis maximè conspicuum est vnamquaque superiorem insinuari in aliam subiectam sibi. At verò summas duas nullus processus, sed ambiens membrana copulat. Sola autem suprema medium eminentem quasi ramum et extimum non nouit: hunc reliquae

pack mules carry huge weights on their spine, so in man the weight of the body is held upright by it. To meet the requirement of actions when a man needs to bend and twist, it is assembled together from a number of bones like knots, called by us *vertebrae*, all of them supported on the sacrum. For the whole spine extends out into four parts: sacrum, loins, *dorsum*, and neck. The sacrum, also called “*latum*,” seems at first glance a single continuous bone, but after long thorough immersion in hot water or hot oil consists of six counterparts of *vertebrae*. Another bone is attached to its lowest part and hangs down; the Greeks can call it *coccyx*, and we tailbone. This one too consists of four rounded thin bones, largely cartilaginous. Above the sacrum the loin comprises five bones; upon it rests the *dorsum*, built up from twelve *vertebrae*; next is the neck with seven. So the total number of *vertebrae* in the spine is thirty. The sacrum is the largest, and in size and thickness the lumbar *vertebrae* come next, with a narrow hole through their middle. The rest higher up are less bulky the further they are from the bottom, with a steady decrease in them up to the roots of the occiput. [P4] But in the topmost ones the internal cavity is the largest of all, to leave room for the medulla [i.e., spinal cord] running down; it gets smaller with the medulla’s progressive decrease in size. To put the point once and for all: the upper *vertebrae* with the empty spaces within them are large but light in weight; the lower ones, on the other hand, are all remarkably well built for resilience [*δυσπάρθειαν*], and have taken on a different shape to make their structure more secure. Where they adjoin the intestines inside, they are rounded and shaped into a ring, smooth, and without rough prominences; like knobs (hence they have been called *spondyli*) placed one upon another they form a column. Their substance is rather delicate and loose, with intervening empty spaces. Externally manifold processes protrude (the Greeks call them *apophyses*), of a denser and harder substance, and from them the outer surface takes on the appearance of a thornbush. Some of these processes protrude in the midline, others are lateral additions on either side, others lead upwards and downwards, binding and fitting the *vertebrae* together. Apart from the top two, each of the others has on its lower aspect moderate processes on each side directed downwards, and gives off other larger ones from its upper aspect that expand upwards. The structure of the *vertebrae* is such that processes facing upwards have moderate-sized recesses, to receive other processes running down from the vertebra above. In the six lower *vertebrae* it is especially evident that each upper vertebra is molded into [“*insinuari*”] the one below. But the topmost two are linked by the membrane surrounding them, not by any process [of bone]. Only the top one lacks a midline external prominent offshoot; the rest, as

omnes ad decimam vsque dorsi, quae est omnium decimaseptima, deorsum porrigunt: in rectum verò, quaecunque illi subiectae sunt. Tertium ramorum atque processuum genus qui transuersi dicuntur, è vertebrarum omnium atque ipsius sacri ossis lateribus vtrinque prodeunt parte externa. Insunt hi longiores in lumbis, sed graciles quasi pro costis diducti. Breuiiores in superioribus, quo toto dorso in tuberculum desinunt, vbi costae nectuntur. Sex in ceruice summis, transuersi ramusculi in longum perforantur, septimae rarò, caeteris numquam, tametsi singulae quae ad lumbos tendunt, parte interna pluribus patent foraminibus, et quasi angustis in quas venulae commeant, quorum nihil in reliquis magnopere videas. Vertebrarum processuumque omnium extrema cinguntur et circumfunduntur cartilagine permulta, in hanc vincula crassa, dura, et valida inseruntur, quorum beneficio interiores vertebrarum nodi cohaerescunt, vtpote quae inter nodos fusa nexu illos firmissimo colligant. Externae vertebrarum partes processibus implicantur, sursum deorsumque spectantibus, vt aliis aliae nexae, et omnes inter se aptae colligataeque videantur. Praeter haec tamen vinculum membranis validis intextum vniuersam spinam extrinsecus obuoluit. Haec de spina satis, iam de capite. Huius verticem calua integit summa parte globosa et rotunda, introrsus concaua. In hac suturae sunt tres: vna in priore parte quam στεφανιαία, id est coronariam vocant, quia è temporibus vtrinque in summum verticem per transuersum viam capessit: alteram λαμβδοειδή dixere quae in occipite posita, à capitis imo et posterioribus vtrinque partibus sursum contendens, in angulum coit ad Λ. literae figuram. Tertia όβελία in capitis longitudinem porrigitur από τῆς λαμβδοειδοῦς angulo in mediam coronam excurrans. Hunc in syncipite concursum βρέγμα Graeci nuncupant. Atque in iis sunt dentatae more serrae rimarum connexiones, nec vinculis nec cartilagine vinctae, sed suis quasi dentibus pectinatim intextae. Supra aures verò duae sunt illis dissimiles commissurae ab obelaea interuallo pari disiunctae, à squammae specie λεπιδοειδεῖς dictae, per quas ossa quae petrosa vocant subditis ossibus squammarum modo, et (vt nonnulli dicunt) imbricatim agglutinantur. Ea autem sic enumeres. Parte postrema os occipitis id quod cerebellum nominant concludit, quod triquetra sutura circunseptum, ad posteriora deorsum vergit. Omnium quae in capite sunt illud maximo foramine perterebratum, quo medulla è cerebro in spinae fistulam delabitur. Huic vtrinque sinus adiuncti, in quos prima vertebra additamentis quibusdam et appendiculis inseritur. Inde factum os multò

far as the tenth dorsal, that is, the seventeenth of all the vertebrae, present one sloping downwards; those below present one running horizontal. A third kind of processes are called transverse, and protrude externally from either side of all the vertebrae and of the sacrum too. They are longer in the lumbar region, but thin where they are so to speak drawn apart for the ribs. They are shorter in the upper vertebrae, ending throughout the dorsal region in a tubercle where they are linked to the ribs. In the six highest vertebrae in the neck the transverse processes are perforated lengthwise; the seventh is so occasionally, the others never, although individual lumbar vertebrae have numerous openings to their interior, and narrow passages into which tiny veins pass, of which you can see nothing much in the rest. The edges of all the vertebrae and their processes are held in and surrounded by a great deal of cartilage, into which thick, hard, and strong ligaments are inserted. These enable the internal knobs of the vertebrae to stick together, by extending between the knobs and linking them with a very strong bond. The outer parts of the vertebrae are enveloped in processes that face upwards and downwards, so that they seem bound to each other, all fitted and fastened together. In addition there is a ligament woven from strong membranes that covers the whole spine outside. That is enough about the spine; now about the head. Its top is covered by the skullcap, which is rounded in its uppermost part, and concave inside. In it are three sutures: one in the front that is called *stephaniaia*, that is, coronal,⁴ because it runs transversely up on each side from the temples to the top; another called the *lambdoid* in the occiput, which runs upwards from the bottom rear parts of the head on each side and joins up into an angle like the [Greek] letter Λ . A third suture, the *obeliaia* [modern “sagittal”], extends in the midline of the head from the angle of the *lambdoid* to [end in] the middle of the *corona* [i.e., coronal suture]. The Greeks call this meeting place in the *sinciput*⁵ the *bregma*. In the sutures the joints in the clefts are toothed like a saw, and bonded not by ligaments nor cartilage, but by the interlinking of their comblike teeth. There are two junctions above the ears that are different; they are separated from the sagittal suture by an equal interval [on each side], and because they resemble scales are named *squamosal*. They fasten the petrous bones to the underlying bones like scales or, as some say, tiles. So you can reckon the bones thus. At the back the occipital bone encloses what they call the *cerebellum*; it is surrounded by the triangular suture,⁶ and turns downward towards the back. Of all the skull bones, this is the one pierced by the largest foramen, by which the medulla runs down from the brain into the spinal canal. Sockets adjoin it on each side, into which the first vertebra is fitted by certain appendages.⁷ From there the bone, becoming much

angustius ad cerebri radices contendit, vbi per transuersam commissuram vix pollicem longam ei ossi arcè connectitur, quod Graecis à cunei specie σφηνοειδὲς est appellatum. Occipitio latera capitis innituntur, quae syncipitis, nonnunquam et τοῦ βρέγματος [P5] ossa dici solent: haec ad summum verticem acta vtrinque ei commissurae assident, quae recta in capitis longitudinem fertur. Subter haec, duo sunt ad suam quodque auriculam: quae à lapidis specie et duritia λιθοειδῇ dixerunt. In horum cauo ossa duo visuntur malleo aut incudi similia. Ab vtroque processus quasi surculus intrò subit στυλοειδῆς, in quo foramen quo soni admittantur intrò fertur ad cerebrum. Extra promittuntur duae eminentiae, altera mammae similis parte postrema sub auris via, altera teres et procera sub temporibus eminens, quae ossi iugato committitur. Os sextum frontis est, quod in superciliorum sede vbi eminet duplex est, concluditque gemina facie inanem capacitatem in nares deriuatam. Pars superior coronaria sutura cingitur, inferior in oculorum caua reflexa, summum in his parietem facit. Finitimum hoc ossibus faciei, à quibus tenui commissura determinatur, vtrinque à temporibus et saxeis ossibus prognata, quae oculorum caua dirimit, inde ad summum nasum se applicans vbi superciliis interiecta vallis est. Iam his totique cerebro ceu basis quaedam substernitur os σφηνοειδὲς, quod qua parte occipitis ossi iungitur, angustum est et raram, attamen profundum. Parte priore frontis ossi occurrit et annectitur, in ea via quae in nares procliuis fertur. Varia in hoc cernuntur vtrinque foramina, per quae sentientium neruorum propagines dimanant in sensus. Sub interiore eius facie capacitates duae latent, in quibus est illud rete plenum admirationis, aliáque cerebri arcana. Processus concauos emittit ab alarum similitudine περρυγοειδεῖς vocatos, alterum sursum ad caua temporum, frontis ossi et ei quod à lapide nomen habet commissum, alterum canalis et tubi instar deorsum ad postremos dentes versum, qui reflexo extremo palatum terminat eíque committitur. Nunc de facie. Faciem totam geminam discernit ea commissura, quae ab interuallo superciliorum per medias nares inter primores dentes producta, palatum in longitudinem secat. Maximum in ea est os malae, in quo dentium superiorum radices figuntur: excurrit id intrò ad palatum, pars verò eminentior sursum effertur ad nasi latus et maiorem oculi angulum. Supra

narrower, reaches the roots of the brain, and there is tightly linked by a transverse connection barely a thumb long to the bone named sphenoid by the Greeks, because it is wedge-shaped. [P5] The sides of the head rest upon the occiput, and these bones [the parietal bones] are called the bones of the sinciput, and sometimes the bones of the bregma. Running up to the top of the head on each side, they meet at the [sagittal] suture that runs straight the length of the head. Below these there are two bones [the temporal bones], one at each ear; having the look and hardness of stone, they are called lithoid [nowadays petrous]. In their recess [the middle ear cavity] two bones can be seen like a hammer [the malleus] or an anvil [the incus].⁸ From each a twiglike process resembling a pen runs inward, in which the orifice by which sounds are admitted runs into the brain. Outside, two prominences are present: one like a breast at the back below the ear channel, the other rounded and long below the temples, which is connected to the zygomatic bone. The sixth bone is the frontal, which is double where it protrudes at the base of the eyebrows, and encloses by its twin surface an empty space draining into the nose. The upper part is bounded by the coronal suture, and the lower is bent back into the eye sockets and forms their upper wall. It is close to the bones of the face, from which it is separated by a thin junction, arising from the temples and the petrous bones on each side, that divides the eye sockets and thence attaches itself to the top of the nose, where there is a groove interposed between the eyebrows. Underlying these [bones] and the whole brain like a kind of foundation is the sphenoid bone, which is narrow and thin where it joins the occipital, though deep. In front it meets and joins the frontal bone, on the route that leads downward into the nasal cavities. Various channels are visible in it on either side, through which the branches of nerves of sensation spread out into the senses [i.e., sense organs]. Two cavities lie hidden below its internal surface, in which there is that remarkable network,⁹ and other secrets of the brain. The sphenoid gives off two hollow processes named “pterygoid” because they resemble wings: one upward towards the temporal hollow [the “middle fossa” of today], the frontal bone and the bone named after “stone”;¹⁰ the other like a channel or tube, running down towards the back teeth, and ending with a junction to the bent end of the palate. Now for the face. The junction that runs from the gap between the eyebrows through the middle of the nose and between the front teeth, to divide the palate in its length, splits the whole face in two. Its largest element is the cheekbone, in which the roots of the upper teeth are inserted. It runs inwards to the palate, but a higher part passes upwards to the side of the nose and the medial¹¹ angle of the eye. Above the

radices dentium maxillarium capacitas ingens concluditur, ad oculi sedem sursum lata, quam alba ac similis glandis substantia communit. Superiore maxilla (quam propriè malam Celsus appellauit) ad radices primorum qui secant dentium, ossa duo sita sunt, intus duntaxat lineis distincta: rursúmque duo perexigua quo loci interstitium est narium, et vnde superius labrum enascitur. Quae quatuor tenuissima cùm essent et obscuris lineis separata, maxillae superioris partes effecimus, ne quenquam fortè multitudo tanta obrueret. Inter oculum et aurem apparet os editum, iugale vocant, durum quidem et temporum musculo tanquam praesidium et propugnaculum, cuius pars posterior ossi cui à lapide nomen est, in eo exortu copulatur, qui oblongus ab aure aduersum spectat: pars infera ossi maxillae, supera ad oculi paruum angulum frontis ossi cohaeret. Nasus ossa duo gestat, quadrangula, procera, à iugo nasi deorsum per illius longitudinem ducta, in quorum extrema cartilagines inseruntur alae vocatae. Vtriusque oculi fossae tria substituuntur ossa, praeter ea quae veluti parietes sunt aut frontis, aut malae, aut zygomatis, aut productionum quae à cuneo manant. Horum siquidem omnium extrema in oculorum sedes concurrunt, lineis discreta conspicuis. Trium quae dixi maximum, ad minorem oculi angulum collocatur, quod à zygomate et frontis interiore pariete, obscurae vix dirimunt commissurae. Alterum conspiciendum magis fossae parte infima, ferè ab eo malae foramine quo neruus in labra superiora deducitur, intrò recurrens, auricularis digiti latitudine. Tertium oblongum tetragonum ad oculi angulum maiorem positum, malae superioris extremo à latere annexum. Inter palatum et cerebri basim vsque ad nares vtrinque diuersa disiecta sunt ossa, tenera quidem atque tenuia, sed quae tertij huius propagines videri possint. Ea variè contexta spongiae formam referunt, vt dubitare non liceat tertium illud hoc esse, quod Graecis σπογγοειδὲς appellatur. Praeter id ad summam nasi radicem, intus fixum haeret aliud tenue et latum, magno illi obtrusum foramini, quo è cerebro in nares cursus est: hoc variè pertusum more cribri Graecis ethmoides dicitur, ab eo diuersum quod est spongoides. Illius è medio mittitur eminétque ad cerebrum quasi verruca praedura: deorsum autem per medios narium sinus ducitur ἑκφυσις la-[P6] minae specie, quae nares aequè discriminat geminásque reddit, hanc nobis liceat Macrobij verbo narium interstitium appellare, cui cartilago innascitur nasi pars infima.

roots of the teeth of the upper jaw a large cavity [the maxillary antrum] is enclosed, extending up to the orbit [“oculi sedem”], and protected by white material like a gland. In the upper jaw (Celsus correctly called it “mala”), at the roots of the incisor teeth, there are two bones marked out inside at least by lines, and two more very small ones at the central partition [“interstitium”] of the nose, at the origin of the upper lip. As these four are very slender and separated by ill-defined lines, we have completed the account of the parts of the upper jaw, in case anyone should be overwhelmed by such a large number of them. Between the eye and the ear is a prominent bone, called the zygomatic [“iugale”], a hard one and a protecting bulwark for the temporal muscle. Its back part is linked to the petrous bone’s oblong process that faces away from the ear to meet it. Its lower part joins the bone of the upper jaw, and its upper part joins the frontal bone at the small [i.e., lateral] angle of the eye. The nose possesses two bones, quadrangular and long, running down from the bridge of the nose along its length, and the cartilages named wings are inserted into their ends. Three bones underlie each orbit [“oculi fossa”], besides those that are sides of the frontal bone, the maxilla, the zygoma, or the processes that arise from the sphenoid. The borders of all these in fact run together into the orbit, separated by well-marked lines. The largest of these three lies at the lateral [“minorem”] angle of the eye, and ill-marked junctions barely separate it from the zygomatic and the internal wall of the frontal.¹² Another is to be seen more at the lowest part of the orbit, running inwards nearly from the foramen of the maxilla that conveys the nerve into the upper lips [the infraorbital foramen], the width of the little finger.¹³ The third is oblong and four-sided, lying at the medial [“maiolem”] angle of the eye, and attached to the end of the upper maxilla by its side.¹⁴ Between the palate and the base of the brain, as far as the nose, there are various dispersed bones, soft and thin, but appearing to be extensions of this third bone. Their varied structure resembles that of a sponge, so that no doubt remains that this third bone is the one called “spongelike” by the Greeks.¹⁵ In addition to it, another thin wide bone at the top of the root of the nose is fixed inside, blocking the large foramen that forms a path from the brain into the nostrils. This is pierced in various ways like a sieve, hence the Greeks call it the ethmoid, and it is different from the spongelike bone. Prominent from its middle there runs towards the brain a sort of very hard wart [the crista galli]; and a process passes downwards through the middle of the nasal passages like a thin plate, which separates the nasal passages equally into two. [P6] This, to use the term of Macrobius,¹⁶ can be named the interstitium of the nasal passages, in which a cartilage arises to form the lowest part of the

Parte interiore alterum existit palati interstitium, quod malae propago quaedam est, vt ipsa quoque mala geminum. Id à supera palati parte natum cuneo innectitur pede firmissimo, sursúmque sese erigens dum narium interstitio occurrat et committatur, interiorem palati cauernam dirimit facítque geminam. Haec veteres anatomici, tanquam nulla essent, silentio praeterierunt, quae (quoniam tenella) minimè in iis capitibus cernas quae putida sunt atque confecta, verùm singula monstrabit purgatio diligens, móxque ex feruente oleo facta dissolutio. Maxillam inferiorem duo conficiunt ossa mento extremo strictissimè agglutinata. Vtrinque summis ab extremis duo veluti cornua prominent: alterum prius quod tendones ex temporum lacertis asciscit, alterum posterius in exiguum sinum τοῦ λιθοειδοῦς, quod sub audiendi via se inserit, non quidem cartilaginosa aut serrata compage firmatum: sed vinculis quae motum liberum et expeditum cardinis modo maxillae permittant, vt sit mobilis vna ex omnibus capitis ossibus. Hac enumeratione quae integra et absoluta censetur, totius capitis ossa duo sunt et viginti: sex caluae, deinde cuneus, duo zygomata, faciei vndecim, maxillae duo. In facie enim numerantur malae ossa duo, nasi totidem, in oculorum antris sex, ethmoides seu cribrum vnum, cuius narium interstitium portio quaedam est: palati autem interstitium apophysis est malarum. In horum numerum si quae ad primorum dentium radices sunt, rursúmque duo ad narium ingressum posita referes, erunt omnia sex et viginti. In linguae radice à caeteris discretum os existit, quod à ὅ specie ὄοειδοῦς appellarunt. Vtraque porrò maxilla crebrò perfossa quibusdam quasi alueolis, vt in singulas fossas singuli dentes infigantur. Hi autem quaque mala ferè sexdecim sunt, raro plures, pauciores nonnunquam: ex iis quaterni primores dicuntur à nostris, à Graecis (quia secant) τομικοὶ et τομεῖς. Post hos canini sunt vtrinque duo, vltra quos maxillares vtrinque quaterni, quorum duo vel plerunque tres vltimi et intimi, qui aliis nunquam, aliis serò gigni solent, genuini vocantur. Primores et canini vnica radice nituntur, maxillares binis aut ternis aut quaternis, atque inferiores vna minus quàm superiores. Is est ossium capitis numerus eaque structura. Thorax totus dorso innititur, cuius duodecim articulos numerauimus, vnde et costae vtrinque duodecim. Proditum est à Galeno nonnunquam vnam

nose. Further inside there is another interstitium,¹⁷ of the palate; the palate is a sort of extension of the maxilla, and twinned [i.e., one on each side] like the maxilla itself. It arises from the upper surface of the palate and is linked to the sphenoid by a very firm base; raising itself upward as it meets the interstitium of the nasal passages and joins it, it divides the internal cavity of the palate into two. The ancient anatomists passed over these structures in silence as if they did not exist, since they are thin and you can see them hardly at all in heads that are decayed and finished with, but the details will be revealed by careful cleansing, and later by separation done with hot oil. Two bones compose the lower jaw, tightly bonded at the point of the chin.¹⁸ On each side, right at the top two horns protrude. The front one receives tendons from the temporal muscles; the back one is secured into a small recess of the petrous bone running in below the auditory channel, but not by a cartilaginous or serrated joint; it is secured by ligaments to allow the jaw free and speedy movement like a hinge, so that of all the bones of the head this one alone is mobile. By this reckoning, which is taken as complete and final, the bones of the whole head number twenty-two: six of the skullcap, then the sphenoid, two zygomatics, eleven of the face, two jaws [i.e., two parts of the mandible]. In the face the cheekbones ["maxillae"] number two, and the nasal bones the same number, six in the eye cavities, and one ethmoid or sieve-bone, which is a part of the central partition of the nose (the central partition of the palate is a process of the cheekbones). If you add to their number those at the roots of the incisor teeth, and two situated at the entrance to the nose, there will be twenty-six. In the root of the tongue, separate from the rest, is a bone that they call hyoid from its U shape. In addition, each jaw is pierced by small recesses, to accommodate each tooth in a socket. The teeth number about sixteen in each jaw, occasionally more, sometimes less. Of these there are four together [i.e., two on each side] that we call "primores," and because they cut, the Greeks call them "tomikoi" and "tomeis" [incisors]. Behind them are two canines on each side¹⁹ and over and above these four molars ["maxillares"] together on each side, of which the two or (commonly) three at the back and furthest in, that erupt in some people never, and in others late, are reckoned genuine. The incisors and canines rest upon a single root, the molars on two or three or four together, and the lower teeth on one less root than the upper ones. We have now covered the number of the bones in the head and their arrangement.

The whole chest rests upon the dorsal spine ["dorso"], of which we have counted twelve components ["articulos," apparently the vertebrae], from which twelve ribs arise on each side. We have it from Galen²⁰ that sometimes one is

deesse, vnam rarò accedere, quod inter portentosa connumerem. Itaque vnicuique vertebrae ad radicem transuersi processus, sinus inest leuiter concauus, qui costae principium extanti tuberculo, quod illius est caput, excipit. Illinc costa originem ducit, quae non ita longè transuerso processui arcè deuincitur: deinde in priora thoracis inclinans curuatur, cùmque ita multum prodiit, protinus in os pectoris curuata resilit. Septem superiores integrae atque perfectae cum pectoris osse committuntur extremis cartilaginosi, et in leues sinus illius ossis conduntur. Nectuntur autem tenuibus membranarum vinculis, quae sunt tam multa vt omnia velent et obducant, atque vix à sensu noscantur. Os ipsum pectoris quod στέρνον appellant, ex septem ossibus constat in transuersum cohaerentibus, vt singulis integris costis singula pectoris ossa respondeant. Ab ossis huius extremo dependet cartilago oblonga, quae a Graecis ξιφοειδής, id est ensis effigie ducta nuncupatur, a iunioribus malum punicum.⁷ Reliquae inferiores quinque costae neutiquam ad os pectoris perueniunt, sed inchoatae et quasi mutilae in cartilagine finiuntur, quae sursum retortae inter se quasi conglutinatae cohaerent, inde nothas et adulterinas appellarunt. De humero et brachio, quae his velut affixa innituntur, dicendum. Regionem totam quae ponè pectus sita est, scapulas appellant, in quibus ossa duo sunt lata, figura triquetra, externa facie tumescente, interiore reducta. Haec sunt ὀμοπλάται Graecis, Latinis scoptula⁸ operta, nonnunquam et scapulae. Quà in dorsi spinam deuexa sunt, lata videntur et praetenuia, hinc paulatim crassiora facta coarctantur, tandem eminent ad extremum acutiora. Id genus ossis alteri nulli commissum, costis posterioribus velut innatat, parte ima non mediocriter cartilagine obductum, vbi validis musculis neruisque constringitur. Extremum autem angustius (cervicem quidam appellant) quasi in acetabulum desinit, quod humeri caput exci-[P7] pit. Interiore ex parte exiguus acutusque ductus exit, qui à coruini rostri similitudine κορακοειδής vocatur a Graecis. Alterum quasi ramum externum, magnum quidem et à suprema ossis parte natum ἄκρωμιον dicunt: solius is est hominis sub finem leuiter sinuatus, quà iugulum clauésque admittit. Os enim in pectore summum iugulum est, quod supremae costae incubans dextra laeuáque ad scapularum ossa promanat, acromiis vt dixi affixum. Duo sunt iuguli ossa, pectoris ossi in transuersum commissa, quae et figura et crassitudine sunt inaequabili, plurimúmque more fistulae perforata.

absent, or occasionally there is a supernumerary one, which I would reckon a monstrosity. In each vertebra, at the root of the transverse process, there is a shallow recess that receives the origin of the rib by a protruding tubercle that is the rib's head. The rib starts from there, and is closely bound to the transverse process over a short distance. Then it bends downwards and curves toward the front of the thorax. When it has gone thus far, it rebounds and curves onward to meet the chest bone [sternum]. The seven upper ribs are whole and complete, and join the chest bone by cartilaginous ends, which are let into shallow recesses in that bone. They are also linked by thin membranous bands, so numerous that they cover and obscure everything, and can hardly be discriminated by our senses. The chest bone itself, which is called the sternum, consists of seven [in fact five] bones sticking together transversely, so that individual chest bones correspond to individual whole ribs. An oblong cartilage hangs down from the end of this bone; the Greeks call it the xiphoid, a name drawn from its resemblance to a sword; younger men call it the pomegranate. The remaining five lower ribs do not quite reach the chest bone; they terminate, incomplete and in a sense mutilated, in cartilages that bend up and stick together as if glued, so they are called false and bastard.

We must [now] deal with the upper arm and forearm, which hang upon the ribs as appendages. The whole region lying behind the chest is called the scapulae, in which there are two wide bones of triangular shape, convex in outside appearance and concave inside. These are in Greek the *omoplatai*, and in Latin the *scoptula operta*, and sometimes the *scapulae*. Where they run down to the dorsal spine they look wide and very thin, but from there they gradually narrow and thicken, and their end is prominent and quite sharp. A bone of this kind is not jointed to any other,²¹ and can be said to float on the back of the ribs. Its lowest part is covered with a good deal of cartilage, where it is bound up in strong muscles and nerves. But its narrower extremity, which some call the neck, ends in a kind of cup that receives the head of the humerus. [P7] A small sharp process ["ductus"] comes out from its internal part, and because it resembles a crow's beak is called the coracoid by the Greeks. Another external branch, large and stemming from the topmost part of the bone, is named the acromion. In man alone²² it is slightly curved below its end, where it receives the top of the chest bone²³ and the collarbones. The highest bone in the chest is the top of the chest bone, which lies upon the top rib and proceeds outward on left and right to the scapulae, being jointed to the acromia as I said. There are two collarbones ["iuguli ossa," imprecise term], linked transversely to the chest bone; they are of uneven shape and thickness, and are perforated exactly like a pipe.²⁴

Nunc de toto brachio. Sunt omnes eius partes numero tres, humerus, brachium,⁹ et manus. Humeri os est vnicum, medium teres, durum, medulla inundans omnémque in partem leuiter gibbum, partibus extremis tumidis et cartilagine obductis. Summum eius caput grandiusculum est, globosum, in scapulae sinu (κοτύλην Graeci appellant) collocatum, cui validis vinculis tum intus tum foris ambientibus astringitur. In huius parte externa patula rima inest, ceu via qua ingens tendo cum neruis in brachium tutò com meat. At imum humeri ad cubitum spectans non globosum, sed vno et altero tuberculo vtrinque turgidum est, altero extrinsecus minore, interiore altero atque maiore. Inter haec sinus duo sunt, in quibus cubiti summa pars trochlearum modo conuoluitur: duoque quasi vertices extant in orbem flexi, caua item duo, quorum posterius multò maius est aduerso. Brachium duobus struitur ossibus, quorum maius cubitus Latinis et πῆχυς Graecis appellatur, minus verò illi insidens radius est, Graece κερκίς. Illud summo suo capite medium quasi verticem habet, qui in medium quoque humeri sinum se inserit. Extant et processus duo peracuti vtrinque medium verticem finientes, posterior qui major est, dum cubitus tenditur, in posterius humeri cauum se recondit: prior verò cùm is flectitur, in aduersum. Radius superiori suo capite rotundo et leuiter sinuato, exiguum humeri nodum excipit, illícque robustis vinculis cubito illigatur. Quod in articulo extrà prominet ἀγκών appellatur, cui aduersus est flexus, quemadmodum genu poples. Cubiti radiique media hiantia sunt et disiuncta, quae tamen rursum inferiore parte ad primam palmae partem coëunt, occurrítque cubitus minimo digito, radius pollicis: à cubito processus exit στυλοειδής, cui palmae pars summa insistit. Brachiale nonnulli vocant primam summámque palmae partem, quam et καρπὸν nominant, ossiculis octo constructam, vno quidem ordine tribus, è quibus vnum geminum est, altero quatuor, quae omnia sunt exigua, dura tamen nec medulla perfusa, neruosis cartilaginisque nexibus per συνάρθρωσιν constricta. Totius figura à summo leuiter tumens intus sinuata. Succedit illi μετακάριον, id est ima palma, ossibus quinque contextum, quibus est carpo per συνάρθρωσιν adhaesio. A singulis singuli digiti directè porriguntur vno pollice dempto, qui oblique μετακαρπίῳ videtur additus. Ex ternis ossibus digiti constant singuli praeter pollicem duobus constitutum, priorisque nodus consequentis sinum perpetuò subit. Breuiter, ossibus quatuordecim continentur

Now about the whole arm. It comprises three parts altogether: the humerus [upper arm], brachium [forearm], and hand. The humerus bone is single, smooth in the middle, hard, abounding in marrow and slightly bowed throughout, with ends swollen and covered with cartilage. Its head at the top is quite large, spherical, lodged in the recess of the scapula that the Greeks call the cotyle, and secured there by strong ligaments surrounding it inside and out. There is an open groove or channel in its outer part, along which a large tendon with nerves makes its way safely into the arm.²⁵ But the lower end of the humerus, facing towards the elbow, is not spherical, but bulges in a pair of tubercles, one on each side, the outer one being the smaller, and the other being the inner and larger. Between them there are two recesses, in which the top of the forearm is wrapped around like pulleys, and there are two tips bent into a circle, also two cavities, the back one much larger than the front one.²⁶ The forearm is built from two bones, the larger being called the cubit in Latin and *pechys* in Greek [ulna], while the smaller one lying upon it is the radius, or *kerkis* in Greek. The former has at the top of its head a kind of tip in the middle, which also fits into the central recess of the humerus. There are also two very sharp processes at the end of the tip on each side: the back one is larger and is inserted into the rear recess of the humerus when the elbow is extended; the front one is inserted into the recess it faces when the elbow is flexed. The radius receives a small knob of the humerus in its upper head, which is rounded and gently curved, and it is secured there by strong ligaments to the elbow. The part of the joint that sticks out is called the ankon, and the opposite side is the bend, like the front and back of the knee ["*genu poples*"]. The ulna and the radius are separated in their middle part, and reunite again lower down at the first part of the palm. The ulna meets the little finger, and the radius the thumb. A styloid process emerges from the ulna, on which the top of the palm lies. Some call the first and topmost part of the palm the "*brachiale*" [wrist]; it is also named *carpus*, and is built of eight small bones: three in one row, of which one is a twin bone,²⁷ and four in the other, all small ones, but hard and not full of marrow, and bound in together by nervous and cartilaginous links as a *synarthrosis*. The shape of the whole is gently convex from the top, and concave inside. Next comes the metacarpium, the bottom of the palm, composed of five bones, which are held to the *carpus* by a *synarthrosis*. From each bone one finger originates directly, except for the thumb, which appears as an oblique addition to the metacarpium. Each finger comprises a set of three bones, except for the thumb that has two, and the knob of the nearer bone always enters a recess of the next one. In brief, the fingers are held together and furnished with

aptantúrque digiti, tredecim palma vtraque, duobus brachium, vnico humerus, praeter ea perexigua, quae *σησαμοειδῇ* vocantur, in iuncturis constituta. Haec de superiorum partium ossibus, nunc de inferioribus. Os sacrum magnos rectósque stipites et processus vtrinque emittit, quibus astricta sunt ossa coxarum longè valentissima. Horum autem partes, quanquam discretæ non sunt ob amplitudinem, varia tamen nomina inuenerunt: nam summae, ilium ossa dicuntur, quae intestina sustinent ac tuentur: imae coxendicum, quae à lateribus sinus rotundos habent: hinc in priora ductae partes, ossa sunt pectinis, quae amplis patent foraminibus et media commissura arctissimè conglutinantur. Vtraque coxendix grandi cauatur veluti acetabulo, in quod coniectum femoris caput conuoluitur. Femoris enim vt humeri os est singulare, cuius pars summa ceruicem habet exertam, quae tamen intrò conuersa in coxendicis acetabulum reconditur. Ab ea ceruice exigui duo manant processus, maiorem qui foras exilit alij *γλουτὸν*, id est natem, alij *τροχαντῆρα* magnum dixerunt, minorem verò, *τροχαντῆρα* paruum. Extremum inferius tuberculis est discretum duobus, quibus cruri cohaeret. Est quidem crus omnis eius partis, quae inter genu et talum interiecta est, tibia verò grandioris in ea ossis nomen, hoc summo capite gemino sinu excauatur, vt duplex quoque femoris tuberculum exci-[P8] peret. Alterum in crure os minus externa parte constitutum brachij radio consimile Graecè *περόνη* et sura Latinè appellatum, ad vsque genu non ascendit sed tanto breuius est, quanto parte ima longius apparet opposita tibiae appendice: attamen duo haec ossa suprà infráque coniuncta, mediis partibus dissociantur atque dehiscunt. Femoris et tibiae in genu compagem tegit firmátque extrinsecus patella, os quidem paruum, rotundum et cartilagosum, nulli ossi consertum, sed aliis quasi incubans nexúmque vi tendonum atque membranarum, cui poples est à tergo. Tibiae suraeque partes infimae non modicè vtrinque prominentes, et carne nudae malleoli sunt. Hae talum à lateribus ne excidat arctè comprehensum firmant, quem ex transuerso demersum attingere vix possis. Excipitur autem tibiae fornicatum extremum ea parte tali cui et astragalo nomen est, quae sursum spectat, quaeque dimidiatae propemodum rotulae formam refert, ob id *τέτρωπος* Graecis appellata,¹⁰ eaque vt firma basi crus sustentatur, pes verò ipse quoad licet per eius ossis quadrum

fourteen bones, each palm with thirteen, the forearm with two, the upper arm with one, apart from the very small ones called sesamoids that exist in the joints.

So much for the bones of the upper parts; now for those of the lower ones. The sacrum gives off large straight branches and processes on each side, which hold together the hipbones that are far the strongest [of the whole body, presumably]. Although the parts of these bones are not separate in importance,²⁸ they have been given various names: the topmost parts are called the bones of the ilia, and support and protect the intestines; the lowest parts are the bones of the hips, and have rounded recesses on their sides [the acetabula]; and from there parts run forward and are the bones of the comb [“pecten”], which are pierced by large foramina [one on each side: the obturator foramen] and adhere very closely together by a central commissure [the pubic symphysis]. Each hipbone is hollowed out in a large acetabulum, into which the head of the femur fits and is secured. Like the humerus, the femur is a unique²⁹ bone, and its top has a projecting neck, so that it [probably the top rather than the neck] turns inward and is recessed into the acetabulum of the hipbone. Two small processes arise from this neck: the larger runs outward and is called by some the “glouton” [in Greek], that is, the buttock, and by others the great trochanter; the lesser one is the small trochanter. The lower end [of the femur] is divided into two tubercles, by which it is linked to the leg. The leg is the name of that whole part that lies between the knee and the ankle, and the larger bone in it is the tibia, in the top of which a twin recess is hollowed out, to receive the twin tubercle of the femur. [P8] The other bone in the leg is smaller and on the outer side, like the radius in the forearm. It is called perone in Greek and sura in Latin [now the fibula³⁰]. It does not reach quite up to the knee, but comes short by the same distance as the appendage at its lower end facing the tibia is longer. While these two bones are joined at top and bottom, in between there is an interval between them. The joint between the femur and the tibia at the knee is covered and strengthened externally by the patella, a small rounded cartilaginous bone, not bound to any bone, but lying on the others and secured by strong tendons and membranes, with the popliteal fossa [poples] behind. The lower extremities of the tibia and fibula protrude a good deal on each side, and the malleoli are devoid of flesh. They grasp the talus tightly laterally so that it cannot slip out, and it lies so deep that you can hardly touch it from the sides. The arched lower end of the tibia is received by the part of the talus (also called the astragalus) that faces upwards, and that almost resembles half of a little wheel. Hence it is called by the Greeks tetrurus [i.e., “yoked four together”]; it forms a firm basis to support the leg, and the foot is enabled by the square outline [“quadrum”] of this

flectitur et extenditur. Talo calx πτέρνα Graecè nominata seu basis altera subiicitur, os totius pedis longè maximum et firmissimum, oblongum, omnino nec teres nec quadratum, sed ex quadrato latescens et introrsum arcuatum. Monti pedis nuncupato quem τάρσον et summam pedis plantam vocant, ossa quinque impacta sunt, inaequabilia: imae verò plantae (πεδίον Graeci appellant) totidem, figura tereti et oblonga: digitos omnes explent ossa quatuordecim, singulos quidem praeter pollicem terna, vt sit totius pedis structura ossium sex et viginti vt totius manus vno plurium. Inter digitorum tum manus tum pedis articulos, ossa sita sunt σησαμοειδή, rotunda quidem et plerunque adeò exigua vt sensum omnem effugiant, quemadmodum quae in corde, in gutture, in linguae radice, in aliisque nonnullis partibus haberi traduntur. In his iam omnem videor ossium descriptionem et numerum impleuisse.

De cartilaginibus, articulis, et vinculis. Cap. IIII

Multa sunt à nobis de cartilaginibus in ossium explicatione quadam consecutione proposita, adeò vt nunc cùm neque illarum vsui, neque propriae substantiae rationi tradendae incumbimus, pauca de illis dicenda restent. Plurima ossium extrema cartilago cingit, nullus articulus non laeuitate illa oblitur, nullus expeditè obuolui circunducique potest, neque nervis aut vinculis coniungi nisi quaedam materia intercedat. Praeter eas autem aliae quaedam extant in costarum praesertim (quae adulterinae vocantur) extremis, vbi ossium, ex quibus prodierunt figuram retinent, dum inferiores mutuo colligatae concurrant, superiores verò in suam quaeque sedem ad os pectoris applicentur. Aliae os ipsum ambiunt atqueprehendunt, aliae extrema nasi communiunt molliuntque, vti et malum punicum è sterno pendulum. Aliud cartilaginum genus solitarium per se consistens vixque vlli ossi impactum: in quo eae numerantur, quae in ciliis sunt oculorum τάρσοις appellant, quae in auriculis, in faucibus, in epiglottide, in larynge, in aspera pulmonum arteria, in cordis basi: omnes quidem non ossium, non motus, sed firmitudinis et solidi roboris gratia conditae. In quod genus ea fortasse referri possit, quae crassa densaque et perfossa medium genus articulum implet, de quibus rursum sigillatim suo loco verba faciemus. Iam verò ossium congressus et adhaesio duobus modis fit, altera per articulum, altera per coitum, illam ἄρθρωσιν, hanc σύμφυσιν Graeci vocant. Per hanc quidem ossa

bone to flex and extend within limits. Under the talus lies the calx [os calcis] or alternative foundation,³¹ named pterna by the Greeks. It is much the largest and strongest of the foot bones, and is oblong, not entirely rounded nor square, but expanding from a square shape and bowed inwardly. On the so-called summit of the foot, also called the tarsus and the top of the sole, five bones are installed, all different, and the same number in the lower sole (called pedion by the Greeks), of rounded oblong shape; fourteen bones fill up all the toes, with three to each except the big toe. Thus the whole foot is made up of twenty-six bones, and the whole hand of one more. Among the joints of both fingers and toes, there are sesamoid bones, rounded and generally so small as to escape notice altogether, like those that are alleged to exist in the heart, in the throat, in the root of the tongue and in some other places. Thus I think I have completed the description and enumeration of the bones.

Chapter 4. The cartilages, joints, and ligaments.

A GREAT deal has already been set forth by us about cartilages in a kind of sequence while dealing with the bones, and so now when we are not devoting ourselves to their function, nor to giving an account of their particular substance, little remains to be said about them. Cartilage surrounds a very large number of ends of bones, and every joint is lined with this smooth substance; none can be quickly bent nor rotated, nor be linked to nerves and ligaments, without some intervening material. In addition, there are other cartilages, particularly at the ends of the ribs (those they call the false ribs), that retain the shape of the bones from which they have arisen, while the lower ones are bound together, and the upper ones are apposed to the pectoral bone [sternum], each to its place. Others surround and embrace the bone itself, and others reinforce and soften the end of the nose, like the xiphoid process that hangs from the sternum. Another class of cartilage stands by itself and is hardly pressed against any bone; in this class are reckoned those called tarsi in the eyelids, those in the ears, in the throat, in the epiglottis, in the larynx, in the trachea, in the base of the heart: all created for strength and solidity, not for the bones nor for movement. In this class may perhaps be included the thick compact perforated cartilage that fills the center of the knee joint, on which [since this word is plural, Fernel is probably referring to the whole class still] later we shall have something to say in each case in the appropriate place.

Now bones meet and adhere in two ways: by joint or by union. The Greeks call the first arthrosis and the second symphysis. Symphysis links bones that do

quorum non est motus diuersus, quasi vnum atque idem sint inter se nexu indissolubili cohaerent, ídque vel inter se strictim conserta nullius corporis interposito, vt cùm mollia et rara sunt, veluti in sterno atque mento, vel medio quodam corpore ceu visco agglutinata, quod aut cartilagosum est vt in pectine, aut neruo aut carne plenum. Per articulum vinciuntur ossa mobiliter: quòd si obscurior segniórque motus est vt in costis, in spina dorsi, et metacarpio, Graecis dicitur συνάρθρωσις, ceu firmior quidam articuli nexus. Huius generis suturam esse voluit Galenus et serratam compagem, qualis est in calua frequens, similiter dentium insitionem et commissuram, quae nihilominus videri possint aptius in συμφύσεως ge-[P9] nus conferri. Sin verò conspicuus est et facilis ossium motus, velut in cruribus, in brachiis, in manibus atque pedibus, διάρθρωσις est, quasi laxior articuli copulatio, licet non omnium par sit et eadem laxitas. Ex his promptum facílque sit ossium quae numerauimus adhaesiones, ad suum quaque genus redigere. Nunc de vinculis.

Non quicquid ossa colligat hoc statim nomine dignamur, sed id duntaxat neruosum praedurúmque corpus, sensu [corrected to “sensus” in Errata at end of the volume] expers (nisi forté obtusi) solidum et exangue, quod à summa ossis cartilagine in aduersi caput inseritur. Id nequaquam vna est vbique figura vel magnitudine, sed à loci conformatione et vsus necessitate varium, rarò neruosum, at ferè membranosum est id quod extrinsecus articulum cingit. Quae in calua sunt ossium commissurae, compage dentata cohaerent, non vinculis, vt neque reliqua tum faciei tum capitis ossa. Verùm inferiorem maxillam ad aurium radices vincula connectunt vtrinque praeualida. Caput et ceruicem firmant duo, ab imo ossis, cui à lapide nomen est, ad primam dorsi vertebram, rursúmque duo ex eodem propè loco ad clauium extrema sterníque summa protensa: et quod à tergo ex occipite ad mediam inter ὁμοπλάτας sedem procurrit. Omnia haec quidem ingentia, robusta, procera, teretéque figura. Vniuersam autem spinam extrinsecus ambit vinculum vnicum, amplum, crassum, validum atque neruosum, è secunda colli vertebra in ossis sacri imum et coccygem desinens, omni fibrarum genere contextum, et quasi in progressu complicatum, in medias vertebrarum sedes se coniicit, quò cartilagini immistum constantiori illas adhaesione nectat. At summam vertebram minora quaedam eáque tenuia et laxa imo capiti illigant. Insunt et sua costarum capitibus, astricta illa

not have movement between them, and stick together as if they were one in an indissoluble bond: either tightly apposed with no substance ["corpus"] in between (as occurs when they are soft and loosely made, like the sternum and the chin), or glued together by intervening substance that may be cartilaginous (as in the sternum) or full of nerve³² and flesh. A joint links bones with some freedom to move. If the movement is slow and not obvious, as in the case of the ribs, the dorsal spine and the metacarpus, the Greeks call it *synarthrosis*, since the bond at the joint is quite firm. Galen held that the suture and toothed connection, found often in the brain case, was of this class, and likewise the insertion and embedding of the teeth, although these may seem more suitably included in the class *symphyses*. [P9] But if the movement of the bones is obvious and easy, as in the legs, in the forearms, the hands, and the feet, the joint is a *diarthrosis*, as the connection at the joint is looser, though not equally loose in all cases. From these considerations the classifying of each of the joints of the bones we have enumerated is straightforward and easy. Now to deal with the ligaments.

We do not automatically give this name to anything that links bones, but only to what has nervous and very hard material, devoid of sensibility or perhaps with blunted sensibility, solid and bloodless, that runs from the cartilage at the end of a bone to be attached to the bone head opposite. It is certainly not of the same appearance and size everywhere, but varies according to the arrangement of its location and the constraints of its function. It is rarely nervous, but what clothes the outside of a joint is usually membranous. The junctions of the bones in the skullcap hold together with a toothed joint, not with ligaments, and not like the rest of the bones of the face and head. But very strong ligaments on each side connect the lower jaw to the roots of the ears. Two ligaments running from the bottom of the petrous [temporal] bone to the first dorsal vertebra support the head and neck, and also two extending from nearly the same place to the ends of the clavicles and the top of the sternum.³³ There is also one that runs from the occiput at the back to the space between the shoulder blades.³⁴ All these are very large, strong, long, and of rounded shape. A single ligament surrounds the whole outside of the spine, and is extensive, thick, strong, and nervous, starting from the second neck vertebra to end in the bottom of the sacrum and the coccyx. It is woven from every kind of fiber, and becoming folded as it proceeds, unites itself to the central parts of the vertebrae, where it is mixed with cartilage and links these parts by a stronger bond. But the topmost vertebra [atlas] is fastened to the bottom of the skull by lesser ligaments, thin and slack. The rib heads too have their ligaments, taut and

quidem parúmque laxa: qualia propemodum et illarum extrema cartilaginosa deuinciunt. Lata scapularum ossa vertebris subditisque costis copulant membranae firmissimae, et qui illis sunt interiecti muscoli. In illorum sinum qui summa est ceruice, humeri caput illigatur vinculo, quod instar solidae membranae è sinus supercilio ad humeri verticem pertinens, tum caput ipsum tum ceruicem in circuitu ambit atque firmat. Praeter id tria numerantur quae illi insident rotunda, duo tanquam nerui, tertium paulò his amplius. Humeri verò pars ima brachio adhaeret eo vinculi genere, quod est omnium articularum commune, nempe quod ab ossium extremis ortum, illa extrinsecus circumligat, deuincit, et continet: membranosum id et validum, laxum tamen et flexibile quocunque velis, aliud illi opem confert minùs latum, brachium continens ne circumactum exiliat. Apud carpum ex communi illo genere vnum est, quod tum imum radium imo brachio, tum verò vtrunque carpo nectit, omnia tamen laxè circunsepit. Id mox longius porrectum, omnia insuper quae in carpo et metacarpio ossa recensuimus copulat tegítque. Caeterum singuli digitorum articuli propriis ambiuntur colligantúrque vinculis, quorum quae extrema sunt, vnguium radices mittunt tanquam fruticentur. Iam verò coxendicum ossa coeunt in pube per cartilaginem, similique copulatione ossi sacro ponè connectuntur. Amplo sinu et quasi acetabulo coxendicis caput femoris excipitur, illique adhaerescit, tum communi illo vinculi genere, tum alio nouo intus recondito, quod è summo femoris capite in medium sinum figitur, rigidum id, rotundum ac breue, vt neruus cartilaginosus censi possit. His similia sunt in genu duo, alterum circumfusum: alterum intus ab ea parte natum, qua summi in tibia sinus inter se committuntur, per cartilaginem perforatam traiectum, inter imi femoris nodos medium se coniicit. Aliis quoque duobus latera stipantur, quae vt nerui quidam sunt cartilaginosi. Quatuor ad istorum proportionem tibiae partem imam pedi connectunt: praeter quae alia astant tria iisdem propè sedibus circumiecta. Pedis digitorúmque articuli perinde vt in manu vinculis cohaerescunt: vnde omnis absoluta iam videtur vinculorum explicatio. Vnicum superest, quod à pectinis osse natum in penem contendit: rotundum id et vnum ex omnibus concauum, quodque à publico caeterorum munere deficere videtur. Talis quidem est omnis vinculorum

with little slackness; much the same kind secure their cartilaginous ends. The wide scapular bones [scapulae] are connected to the vertebrae and the underlying ribs with very powerful membranes and the muscles lying among them. The head of the humerus is secured into the recess at the top of the neck of the scapula by a ligament, which is in the form of a solid membrane extending from the ridge ["supercilium"] at the top of the recess to the summit of the humerus, and then winds around the head and neck [of the humerus] and supports them. In addition to this one there are three rounded ones that lie upon it, two like nerves, and the third a little larger than them. The lower end of the humerus is attached to the forearm by the sort of ligament common to all joints, that is, one originating from the ends of the bones, binding them around outside, securing and containing them; it is membranous and strong, but slack and flexible [to move] in whatever direction you wish. There is another narrower one that cooperates with this one, holding the forearm together to prevent it rotating out of position. At the wrist there is one ligament of the common sort, which both links the lower end of the radius to the lower end of the ulna ["brachium"] and links each of these to the wrist, yet rings everything around loosely. Extending further, it links and covers all the bones in the carpus and metacarpus that we surveyed above. But the individual joints of the fingers are surrounded and held together by ligaments that have ends that put out roots for the nails like shoots. The hipbones are joined together at the pubis by cartilage, and are linked behind to the sacrum by a similar union. The femoral head is received in a large cuplike recess [acetabulum], and is held to it by a ligament of the usual kind, and also by a different one [ligamentum teres] deep inside, which starts from the top of the femoral head and is fixed to the middle of the recess; it is stiff, rounded, and short, so that it may be regarded as a cartilaginous nerve. In the knee there are two similar ligaments [cruciate ligaments], one all around it, and another originating from the place where the recesses in the top of the tibia meet each other, traversing the perforated cartilage, and inserting itself in the middle between the knobs of the lower end of the femur. The sides too are supported by two ligaments, cartilaginous as some nerves are. Four comparable ones link the lower end of the tibia to the foot, and in addition three others all around close to the locations of these four. The joints of the foot and toes hold together just as in the hand, with ligaments. Here the whole explanation of the ligaments now seems complete. One remains [suspensory ligament of penis], which arises from the pecten bone [pubis] and proceeds into the penis. It is rounded and alone among the ligaments is hollow, and seems to lack the function common to the rest. The complete insertion of the ligaments is as has

insertio, quae quanto nexus robore vinciant et illigent tum artus, tum ossa quaeque corporis, dum haec conderemus, patefecit comes ille Sebastianus Francisci Galliarum Delphini instructum exercitum in Carolum Imperatorem ducentis veneficus: quem Lugduni praepotentium [Pro] quatuor equorum in contrarias partes horam propè distrahentium nisus discerpere dilaceraréque non potuit, nedum sua compage dissoluere, nisi cum districti gladij in articularum nodos infixi adactique sunt. Nunc autem aliò nobis properandum.

De musculis et tendonibus. Cap. V.

Lacertorum substantia quanquam non vt ossium simplex videtur, hîc tamen statuo de illis facere verba, quòd in partibus externis primas obtinent. Conditus est enim qui dicitur musculus neruorum fibris ad motum accommodatis, his caro circumcreuit tanquam fulciens illarum robur atque confirmans:¹¹ venae et arteriae conspersae, illae quidem ad alimenti distributionem, hae ad natiui caloris custodiam: omnia demum circumscripè tenuis membrana complectitur, musculúmque definit. Tres sunt illius in longitudine partes, origo, medium, et exitus: quas solent quidam caput, ventrem et caudam appellare. Planè neruosum est caput, venter omnibus quae numeraui constat, extremus tendo contextis confusisque neruorum et vinculorum fibris concreuit, vt natura media donatus, durior et robustior ad motum fieret quàm neruus, at vinculo mollior et infirmior: hoc rursum sensus acumine superaret, ab illo verò plurimùm deficeret. Non omnis musculus tendonem habet, sed is duntaxat qui os moturus in summam illius cartilaginem, aut in vinculum se inserit. Figura quidem hic, vti et musculus, varia praeditus, prout loci ad quem pertinet conformatio ferebat. Quocirca non vnus idémque esse potest tum musculorum tum tendonum numerus: sed cùm aliàs vnus musculi plura sint capita pluresque tendones, aliàs plurium vna sit origo vnicúsue tendo, singula seorsum ex propria cuiusque circumscriptione aestimare dinumeraréque liceat, hoc modo. Frontem vnus musculus tegit latus et tenuis, à summo vertice ad supercilia et oculorum radices diffusus, à quo non vt à caeteris eximas cutem, sed sic illi est innexus, vt sit amborum motus vnus, qui supercilia sursum adducit euehítque. Palpebrae superioris (inferior enim perstat immutabilis) duo sunt lacerti: vnus ex maiore angulo qui propter nasum est, ad tarsi medium eiectus, cuius contractione palpebra attollitur: alter

been described; while we were composing the description, the strength of the bonds they create between limbs and between every bone in the body was revealed by the Count Sebastianus, poisoner of Francis Dauphin of France who led an armed array against the Emperor Charles. [P10] At Lyons the effort of four powerful horses pulling in opposite directions for nearly an hour did not succeed in dragging or tearing him apart, nor even in splitting him by their combined resources, until drawn swords were thrust and pushed into the knobs of his joints.³⁵ Now we must hasten to another subject.

Chapter 5. The muscles and tendons.

THE SUBSTANCE of the muscles does not appear simple like that of bones, but I have decided to give an account of them here, because they hold pride of place in the outer parts of the body. What is called a muscle is constructed from nerve fibers adapted for movement. Around them flesh ["caro"] has grown that so to speak props and strengthens them. Veins and arteries are scattered [within], the veins to distribute aliment and the arteries to guard the native heat. A thin membrane surrounds and envelops it all, and sets bounds to the muscle. Lengthwise it has three parts: the origin, the middle, and the insertion. They are commonly called by some the head, belly, and tail. The head is clearly nervous, the belly consists of all the components I have enumerated, the end of the tendon is assembled from a disorderly weave of nerve and ligament fibers. So a muscle, having been provided with an intermediate nature, became harder and stronger than a nerve for movement, but softer and weaker than a ligament. Its keenness of sensation outdid a ligament's, but fell far short of a nerve's.³⁶ Not every muscle has a tendon, but only one that to move a bone is inserted towards the top of its cartilage, or into a ligament. A tendon, like a muscle, has a shape varying as the arrangement of its situation required. Hence the number of muscles and of tendons cannot be the same. But since at one place a single muscle has several heads and tendons, while elsewhere several muscles share one origin or one tendon, it may be possible to reckon and count single muscles separately by [noting] the individual boundary of each, in the following fashion. One wide thin muscle covers the forehead, spread from the top of the head to the eyebrows and the roots of the eyes. The skin cannot be peeled from it as in other cases, but is so bound in with it that both move as one, drawing up and wrinkling the eyebrows. The lower eyelid does not move, but the upper lid has two muscles: one from the medial angle close to the nose, running out to the middle of the tarsus and raising the lid by its contraction, and the other from

ex minori angulo eodem attingens, qui oculum claudit: vtrique enim ob tarsi firmitudinem palpebra tota cedit. In orbe oculi septem continentur, quatuor recti, quorum vis est mouere sursum, deorsum, ad maiorem minorémque angulum: duo praeterea obliquè positi illum circumferunt, septimus opticum ex cerebro neruum obuoluit et quasi circummunit et obuallat, ne qui tener et mollis est, vehementer concussus laxetur aut obteratur oculúsque demum excidat: quod in illius quoque paralysi solet accidere. Ex fibrarum quas emittit varietate, alij hunc duplicem, triplicem alij esse dixerunt, cùm tamen sit fibrarum quae in eo sunt omnium idem vsus. Ad inferiorem maxillam excurrit latus musculus, qui suprà os petrosum et tempora ambit, deinde contractor factus, sub os iugale se recondit, prolapsúsque longiùs non à fine instar caeterorum, sed à medio tendonem emittit magnum et praeualidum, in summum maxillae adactum: quo sursum illa adducitur et os clauditur animalis. In tanta motus vi et impetu illi venit adiutor alius in ore delitescens, qui post maxillares dentes sursum in os capitis erigitur. Os autem aperit maxillámque diducit musculus ex tuberculo ponè radicem auriculae natus, deinde applicatus imae parti maxillae adusque mentum: huius extrema carnosa sunt, pars media quae amygdalas integit membranosa, veram tendonis speciem ostendat, huiusmodi figura et compositio caeterorum nulli concessa. Musculus circumducens maxillam *μασσητήρ*, id est molitor dictus, quòd mandendo plurimùm valeat, trianguli speciem refert, cuius summum ad tempus figitur: latus vnum ad iugalis ossis imum, alterum ad inferiorem maxillam protenditur, tertium velut basis illa copulans per maxillae longitudinem excurrit. Vt autem necesse fuerat motum eius multiplicem in mandendo et varium fieri, ita neruorum fibris diuersis omnisque generis hunc implicari contextíque par erat. Ex maxillae igitur lacertis¹² maximus is est qui ad tempora peruenit, secundo loco masseter appellatus, tertio qui illam aperit, minimus adiutor. Ad labra vtrinque pertinent musculi duo, capitibus quidem con-[P11] spicui, obscuri verò dum in cutem sparsi obliterantur: prodeunt quidem à malis et obliquè feruntur, alter in superum, alter in inferum labrum. Quatuor hi officio concordēs, labrorum motus octo possunt efficere, quatuor quidem rectos, sursum, deorsum, ad dextram, ad laeuam: alios quatuor cùm vel plurimùm separantur dísiunguntúrque [*sic*: double accent] labra, vel coeunt et alliduntur, vel inuertuntur, vel intrò adiguntur. Eandem quam illi originem sub temporibus habet exiguus musculus,

the lateral ["minore"] angle, touching the same place and closing the eye. The whole of the lid responds to either because of the rigidity of the tarsus. Inside the orbit there are seven muscles: four recti, with the power to move [the eye] up, down, or toward the medial or lateral angle; two more that lie obliquely rotate the eye; and a seventh encases the optic nerve from the brain and so to speak fortifies and secures it, in case (being delicate and soft) a violent shock should stretch or bruise it, and in the end the eye should fall out, as commonly occurs in paralysis of this muscle. The fibers it puts out differ so much that some call it a double muscle and others a triple one, but all the fibers in it have the same function.

A wide muscle runs out to the lower jaw, which in its upper part envelops the petrous bone and the temples; then contracting it conceals itself behind the zygomatic, and running further down gives off a large very strong tendon, not from its end like other muscles, but from its middle. The tendon runs to the top of the jaw, and draws it up and closes the mouth.³⁷ To assist it in a movement of such force and vigor another muscle [medial pterygoid] lurks in the mouth, which rises up behind the teeth of the [lower] jaw into the skull. And a muscle [digastric] opens the mouth and pulls apart the jaw [i.e., jaws] that arises from a tubercle behind the root of the ear, and then clings to the lower part of the jaw as far as the chin. Its ends are fleshy, but the middle that overlies the tonsils is membranous and presents the genuine appearance of a tendon, no other muscle showing such a shape and architecture ["compositio"]. The muscle that pulls the jaw around, called masseter, that is, grinder, because it is particularly strong for chewing, has a triangular form, and the apex of the triangle is attached to the temple. One side extends to the bottom of the zygomatic bone, another to the lower part of the jaw, and the third is the base linking them and runs lengthwise along the jaw. Its motion had had to become complex and varied in the course of chewing, and thus it was right for it to be intimately woven from diverse nervous fibers of every sort. So the largest of the jaw muscles is the one reaching the temples, the next is the one named masseter, the third is the one that opens the jaw, and the smallest is the one that assists.³⁸

[P11] Two muscles belong to the lips on each side, obvious at their heads, but indistinct when they vanish dispersed into the skin. They originate from the cheekbones and proceed obliquely, one to the upper and one to the lower lip. These four in coordination can bring about eight movements of the lips. Four are straight: up, down, to right and to left. The other four occur when the lips are widely opened and separated, or are closed and smacked together, or are pursed, or are drawn inward. A small muscle shares with them an origin under

illos aliquantum comitatus, mox deinde obliquè in alas nasi deflectens, vtrinque vnus. His ergo musculis facies tota comprehenditur. In collo et ceruice complures sunt, qui caput vniuersum mouent. A tuberculo, cui nomen est á [*sic*; “à” 1554] mamma, vtrinque ad clauiculam et sterni summum profertur vnus, tendonem illic magnum comitatus: hic caput et ceruicem deflectit non omnino rectè, sed aliquantulum obliquè, quem alij simplicem, alij triplicem statuere solent ex fibrarum varietate. Duo alij sub oesophago siti, ab osse capitis in primam et secundam colli vertebram inseruntur, quorum est solum caput in priora flectere immota ceruice. Retrò autem octo sunt exigui, qui in ambitu ab osse capitis in primam et secundam vertebram se figunt: ipsúmque articulum multo robore confirmant, vti et duo qui sub oesophago iam sunt descripti. Quatuor ex his recti sunt et in rectum motus agunt, duo obliqui, reliqui item duo obliqui, at situ aduerso. His alij insident octo ab occipitis osse per totam ceruicem eiecti, quorum duo summi ampliores sunt vt reliquos possint contegere. Variis praediti sunt neruorum fibris, quae omnes è septem colli vertebra dimanarunt: vnde aliis plures, aliis pauciores octo creduntur. Hi caput retrorsum flectunt, cum hoc autem ceruicis aliàs duas, aliàs tres, aliàs omnes vertebra. Lateribus colli vtrinque duo insunt magni atque validi, alter ex secunda vertebra in priora, alter ex prima retrorsum contendit, caput et ceruicem ad dextram laeuámque conuersione modica flectunt. Horum est igitur caput et ceruicem mouere, quos vna quidem ratio quatuor et viginti, alia octo et viginti dinumerat. Tres porrò cartilagineae quae in structura sunt laryngis musculi complures continent: quatuor enim primam secundae nectunt, et huic illam adiungentes laryngis partem imam occludunt. Alij quatuor secundam tertiae copulant: quorum contractu summa pars laryngis aperitur. Duobus aliis prima tertiae cohaeret, quorum interest summam partem laryngis intercludere. Sunt et alij duo ad totius basin et radicem, qui istis veniunt adiutores. Praeter istos laryngem alij octo circumstant, qui illum vicinis corporibus copulant, cúmque necessitas est, distendunt vel contrahunt. Quatuor haerent in faucibus,

the temples, and after accompanying them for a certain distance, soon turns obliquely into the wings of the nose; there is one muscle on each side. Accordingly the whole face is enclosed by these muscles. There are a number of muscles in the neck, which move the whole head. One extends from the tubercle named after the breast [mastoid process] to the clavicle and the top of the sternum on each side, running with a large tendon there. It bends the head and neck, not entirely in a straight line but somewhat obliquely, and some usually regard it as a simple muscle, but others as a triple one because of the diversity of its fibers. Two other muscles lying below the esophagus proceed from the skull to be inserted into the first and second cervical vertebrae; their role is simply to bend the head forward without moving the neck. But behind there are eight small ones, which form a ring starting from the skull to be attached to the first and second vertebrae. They provide much strength for the joint itself, as do the two under the esophagus already described. Four of these are straight and perform straight [i.e., forward or backward or left ear down or right ear down] movements; two are oblique, and the other two are oblique, but in the opposite position. On top of these lie a further eight muscles that run down from the occipital bone through the whole neck, and the two on the surface are larger so that they can cover the rest. They possess various nervous fibers, which all spread out from the seven cervical vertebrae; consequently some believe there are more than eight, and some less. They bend the head backwards, and with it sometimes two, sometimes three, or sometimes all the cervical vertebrae. Two large strong muscles lie in each side of the neck, one from the second vertebra running forward, and one from the first running backwards; they bend the head and neck to right or left with a degree of rotation. These are the muscles that move the head and neck, numbering twenty-four on one basis, and twenty-eight on another.

Further, several muscles link three cartilages that are in the structure of the larynx; four of them [cricothyroids, pars obliqua and pars recta of each side] secure the first cartilage to the second, and by binding them together they close the lower end of the larynx. Another four [cricothyroids, posterior and lateralis of each side] link the second to the third, and when they contract the top of the larynx is opened. The first is united to the third by two others, [thyroarytenoids of each side], whose business is to close the top of the larynx. There are two others at the base of it all, [perhaps the arytenoids] that aid the rest.

In addition to these, eight others surround the larynx; they connect it to nearby structures, and dilate or contract it when required. Four cling to the

duo è pectore sursum ducti, fauces et gulam ad alimentum deducendum deorsum vellunt: duo reliqui sursum, quorum situs est aduersus. Os in radice linguae, ὁοειδὲς dictum, nectunt atque stabiliunt octo muscoli, duo ex inferiore maxilla nati, duo sub mento, reliqui ex tuberculo, quod est ad aurium radices. Ad linguam illinc quoque duo protendunt per latera, duo ex ossis parte suprema per linguae medium: inter vtrosque alij duo in longitudinem porriguntur ab ossis lateribus prognati. Similem propemodum productionem habent alij duo, quos edit inferior maxilla. Octo his musculis lingua quoquo versum flectitur, omnesque naturales obit conuersiones. Praeter quos nonus est coniugij expers, ab osse quod ὁοειδὲς Graeci vocant ductus, qui linguam intrò contrahit atque reducit. Idem hic laxatus atque porrectus linguam exerit et foras expellit: quod caeterorum musculorum nulli datum est, vt motuum sit opifex contrariorum. Est enim simplex sua cuiusque actio, qua ad capitis sui et ad nerui originem adducitur. At cùm nullus neruus in linguae extremum extrinsecus inseratur, qui foras illam rapiat, probabilius est hanc eductionem illi musculo attribuire, quàm cum quibusdam fateri motum quendam voluntarium in nobis esse, cuius nullus musculus aut neruus sit author. Hactenus qui superant clauiculas musculos coniunctè recensuimus: nunc reliquos separatim persequamur, qui alterutra parte corporis continentur. Pectori foris sparsi sunt muscoli, qui ipsum attollentes ad animam ducendam sunt vsui, è quibus à summis scapulis vnus ad primam costam pertinet: alter ad sextam, tres praeter hos à collo in varias pectoris priores sedes profecti, id latiùs explicant. Est et alius parte posteriore ab imis partibus scapularum ortus, qui in tres velu-[P12] ti digitos discretus iniectusque mediis costarum quàm maximè curuantur, pectus vniuersum reuellit atque distendit. Subter hos autem iacent muscoli inter costas positi vtrinque duo et viginti: in singulis nempe illarum interuallis duo, quorum interior attollens animae inducendae, exterior deprimens ac stringens remittendae author est. Ex anatomicis tamen nonnulli vtròsque ad sui principium adducentes thoracem constringere prodiderunt. Quidam ex fibrarum varietate quatuor hos esse prodiderunt, vt sint inter costas omnes octo et octoginta. Aliorum quorundam musculorum vis est pectus deprimere et coarctare, quorum vnus per dorsum excurrens septem superiorum costarum radices fibris attingit, quem eo nomine pro septem plerique connumerant.

fauces, two of which running up from the chest pull down the fauces and esophagus so as to convey food down; the other two run upwards, in the opposite position [evidently pharyngeal constrictors]. Eight muscles link up and steady the bone in the root of the tongue named the hyoid; two of them arise from the lower jaw [mylohyoid], two under the chin [geniohyoid], and the rest from the tubercle at the roots of the ears [stylohyoid from the styloid process]. Two more extend from there up to the tongue through its sides, and two from the top of the [hyoid] bone through the center of the tongue. Between each of these are two others that spring from the sides of the bone and extend along its length. The lower jaw puts out two more that follow a practically similar course. These eight muscles bend the tongue in every direction and make it undergo all its natural changes of shape. In addition there is a ninth untwinned muscle, arising from the bone the Greeks call the hyoid, that draws the tongue inward and back.³⁹ This same muscle when relaxed and extended pushes out the tongue, so that (unlike any other muscle) it can fashion opposite movements. For each muscle's action is simple, drawing it towards the origin of its head and of its nerve.⁴⁰ But since no nerve from outside is inserted into the end of the tongue to propel it outwards, the likelihood is that this muscle is the cause of the protrusion, rather than what some people maintain, that there is a particular voluntary movement in us that is the work of no muscle nor nerve. Thus far we have discussed the muscles above the clavicles together: now we shall deal separately with the rest, which lie within on either side of the body. There are muscles scattered on the outside of the chest, which by lifting it up serve to draw in the breath, and of these one from the top of the scapula attaches to the first rib; another attached to the sixth, and three further ones running from the neck to various sites in the front of the chest, spread it out and widen it. There is another at the back springing from the lowest parts of the scapula, [P12] which splits into three fingerlike divisions and is inserted into the middle of the ribs where their curvature is greatest. It pulls out and dilates the whole chest.⁴¹ Deep to these lie the twenty-two muscles situated between the ribs on each side; there are two in each interspace between ribs, the internal one raising [ribs] and bringing about the intake of breath, and the external one depressing and constricting [ribs], thus expelling breath. Some anatomists have held, however, that both by drawing ribs toward their origin constrict the chest. Certain anatomists have held, from differences in the fibers of these muscles, that there are eighty-eight between the ribs. Other muscles have the ability to push down and narrow the chest; one of these runs through the back to send fibers to the roots of the seven upper ribs, and most people reckon it under that

Alius per clauiculas ad cartilaginum extrema penetrat, quoad musculum rectum abdominis contingat ac subeat. Horum contractio costarum extrema depellit atque stringit. Eorum autem qui scapulam duntaxat mouent, magnus vnus est et amplius ex capitis osse secundum dorsum productus, altérque tenuis illum semper comitatus scapulam sursum attrahit. Duo alij hanc retrò abducunt, quorum vnus ex colli, alter ex dorsi vertebris proficiscitur. Alius ex dorsi principio in ossis lati caput desinens, id ad colli latera conuellit. Ad priora autem conuertit gracilis eodem insertus, sed ex occipitis osse natus. Sursum scapulam euehit, is quem mox dicemus humerum quoque subleuare. Deorsum verò trahit, qui ab interiore pectore emergens, in partes scapulae imas disseminatur, ísque simul humerum deprimit. Hos musculos alij maiores integunt, quorum tendones in humerum perlati, multiplicium eius motuum fiunt authores. Vnus mediocris ex mammarum sede in humeri caput se confert, ipsumque ad pectus adducit. Alius ex summis partibus eodem porrectus, quò humerus ad thoracis superiora trahitur. Alius magnus ex toto pectore ortus mammae figuram conformat, et ad interiorem mediámque humeri partem desinit. Geminus is est, cuius pars duntaxat inferior incitata humerum infrà depellit, superior altiùs erigit: ambae intentae aequabiliter ad pectus adducunt. Sub istius parte inferna alius enascitur, quo humerus quoque deflectitur. Omnibus his imminet biceps musculus, cuius alterum caput ex interiore clauae prorumpit, humerúmque tendit, et inclinat moderatè: alterum ex osse lato scapularum deriuatum, eum similiter extendit, simúlque ad exteriora reflectit: ambobus autem aequè intentis is porrigitur in rectum, neque quoquam flectitur. Huic assidet alius è vertice lati ossis tractus, cuius est totum brachium attollere, sed quo alius inferior, id a dorsi media aequaliter reflectit. Sequuntur alij duo musculi ex infimo lato osse profecti: alius deinde illis inferior, qui ad posteriora simul et inferiora deducit. Est demum exiguus quidam sub ala, cuius ope humerus citra vllam inuersionem costis illiditur. Sunt itaque omnes ad humeri articulum decem et tres, qui in humeri os infixi id ipsum variè contorquent. Brachium

[one] name instead of seven.⁴² Another reaches through the clavicles to the ends of the cartilages, until it reaches and underlies the rectus abdominis.⁴³ The contraction of these depresses the ends of the ribs and narrows them.

Among those that simply move the scapula, a large one arises from the skull following the spine, and another thin one closely accompanies it to draw the scapula upwards.⁴⁴ Two others draw the scapula backwards, one arising from the cervical vertebrae and one from the thoracic [the major and minor rhomboids]. Another with an origin at the back ends in the head of the scapula [“*ossis lati caput*”] and draws it towards the sides of the neck [perhaps part of trapezius]. A thin muscle turns it towards the front and has the same insertion, but arises from the occipital bone. The scapula is pulled upwards by the muscle we shall soon describe as a raiser of the humerus. But the scapula is drawn down by one that emerges from the inside of the chest, spreads to the lowest parts of the scapula [*serratus anterior*], and also pulls down the humerus. Other larger muscles cover these, and their very broad tendons reach the humerus and bring about its diverse movements. A middle-sized one starts from the bed of the breast to proceed to the head of the humerus, and draws it towards the chest. Another extends from the top parts in the same direction, and draws the humerus to the upper parts of the chest. Another, a large one, arises from the whole of the chest and creates the shape of the breast; it ends at the internal and medial part of the humerus. It is a twin muscle; the lower part on its own pulls the humerus down when it is in action, and the upper part raises it higher; the two draw it towards the chest when both strain equally. Beneath its lower part another arises that also moves the humerus. The biceps muscle hangs down over all these. One of its heads arises from the inside of the clavicle,⁴⁵ and extends the humerus and inclines it moderately. The other originates from the wide bone of the scapulae,⁴⁶ and similarly extends the humerus and at the same time turns it outwards. When both contract equally, the humerus is extended straight forwards, not flexed in any direction. Over biceps lies another muscle springing from the summit of the scapula; its role is to raise the whole arm, but where another muscle acts lower down, this one bends the arm evenly out from the midlines of the back [*deltoid*?]. Two other muscles follow that start from the bottom of the scapula [probably *infraspinatus* and *teres minor*], and then one below them, which draws [the arm] back and down at the same time [*teres major*]. Finally there is a slender one under the armpit, through the action of which the humerus glides over the ribs without any inversion [*coracobrachialis*]. Thus the muscles at the shoulder joint number thirteen, which are inserted into the humerus and bend it in various directions. All of the

(hoc et multi Latini vlnam vocant, vti Graeci ὠλένην) quicumque mouent, humeri os vndique obuallant, quorum duo interiores illud inflectunt, vnus quidem maior ab interiore humeri sede in priorem radij regionem diffusus, alter minor à summo humero intrò conuersus ad vlnam, alteri obliquè insidet ad X. literae similitudinem. Hi pariter intenti cubitum omnino flectunt, at sursum aut deorsum conuertent, si alter altero magis intendatur. Duo externi sunt illis oppositi obliquam positionem nacti, quorum attractu cubitus prorsum extenditur. Quatuor autem vlnam circumferunt, qui ex humeri ima sede nati parte plurima in radium inferuntur, et illum obliquè positi omnes retorquent. Ex his duo qui radium in pronum conuertunt, in profundum demersi, qui verò illum ad supinum ducunt, extrà quidem positi sunt. In brachio musculi sunt duplices, alij carpum, alij digitos mouent. Ex his qui carpo mouendo sunt, duo hunc quidem intrò agunt in interiore brachij regione siti: alter hinc ad paruum digitum, alter ad magnum porrectus. Duo alij eundem extendunt, et ab extera brachij parte tendones mittunt: hic quidem supra paruum digitum, hic verò supra pollicem. Iidem quoque musculorum tendones, carpum tum pronum, tum supinum ferunt: veruntamen in pronum motum, natura insuper quintum musculum illis administrum dedit, qui ab exteriori brachio duplicem tendonem in medium carpum funderet, alterum indici, alterum infa-[P13] mi digito incubantem. Eorum autem in brachio musculorum, qui digitis mouendis sunt, tres parte interiore sibi incumbunt, atque mediam regionem tenent. Omnium maximus et intimus est aliis substratus, qui ad quatuor digitos, tendones tanquam habenas emittit, quorum ope et beneficio primus et tertius vnus cuiusque articulus inflectitur. Alter illi innexus in secundos articulos fibras explicat. Tertius summus et cuti proximus, tendonem tenuem latúmque sub omnem cutem interiorem manus diffundit, vt promptior ea sit in omne opus, et sensu alacriore polleat. Qui digitos erigant, quatuor sunt in extera vlna, regione media: vnus quatuor digitos extendit, suum cuique tendonem impertitus. Sub hoc alter ad inferiorem brachii regionem declinans, digiti minimi et medicinalis¹³ lateribus tendones iniicit. Suprà verò alij duo, quorum hic in pollicem, ille in indicem et medium digitum fibris tendonum expanditur. Trium postremorum vis est, quinque digitos in transuersum atque pronum

muscles that move the forearm (which many Latinists call the ulna, and Greeks call ὠλένην) encircle the humerus; the two interior ones flex it [the forearm], the larger one [apparently biceps] proceeding from an inside origin in the humerus to the front region of the radius, and the smaller one⁴⁷ running from the top of the humerus inwards to the ulna and lying crosswise on the larger one. When these contract equally, they flex the elbow altogether, but turn it upward or downward if one contracts more than the other. There are two external muscles opposed to these and occupying an oblique position, which contract to extend the elbow completely.⁴⁸ Four muscles surround the ulna, which originate from the lowest part of the humerus and are inserted into the radius for the most part, and because of their oblique position they all twist it back.⁴⁹ Of these two run down deep and turn the radius into the prone position, but those that turn it to the supine position lie outside. In the forearm there are two muscle groups: one group moves the wrist and the other the fingers. Of those that are there to move the wrist, two direct it inward and lie in the inside part of the forearm: one extends from there to the little finger; and the other to the thumb. Two others extend the wrist, and send tendons from the outer part of the forearm, one of them running over the little finger, and one over the thumb. The same tendons turn the wrist either into the prone position or into the supine position;⁵⁰ nature has provided an additional fifth muscle as helper in the pronation movement, to give rise to a double tendon running into the middle of the wrist, one part lying on the index finger, and the other on the ring finger. [P13] Of the forearm muscles that are for moving the fingers, three in the interior lie upon each other and occupy the middle region. The largest and deepest [flexor digitorum profundus] underlies the others, and gives out to four fingers tendons like reins, thanks to which flexion of the first and third joint of each finger occurs. Another linked to it spreads out fibers into the second joints [flexor digitorum sublimis]. A third [palmaris longus] lies on top and is closest to the skin; it distributes a thin wide tendon under all the inside of the hand, to ready the hand for every task, and endow it with sharper sensibility. Of the muscles that extend the fingers, there are four at the outer side of the ulna, in its middle part. One [extensor digitorum] extends four fingers, giving each its own tendon. Below this is another⁵¹ running down to the lower part of the forearm, and inserting tendons into the sides of the little and ring fingers. There are two others higher up; one [extensor pollicis longus] spreads out with tendinous fibers into the thumb, and the other [extensor indicis; it is not linked to the middle finger] into the index and middle fingers. The three muscles last mentioned have the ability to draw [all] five digits crosswise and to the prone

deducere. Manum summam musculi integunt septem, omnes interiore facie conspicui: ex his duo maximi, alter sub pollice, alter sub minimo digito, vbi palma altior est et editior. Hi quos diximus tendones iuuant, quorum est digitos ab aliis plurimùm deducere. Tertius medius inter pollicem et indicem constitutus, ad indicem illum adducit. Quatuor reliqui funiculis et tendonibus flectentibus ad digitorum radices cohaerescunt, tenuésque fibras in digitos effundunt, per quas illos in supinum conuertant. Praeter hos alij numerantur vndecim exigui sub palmae lato tenuíque tendone, è quibus duo ad primum cuiusque digiti articulum pertinent: trium reliquorum vnus ad primum pollicis, duo ad secundum. Per hos nexus firmanentur et expeditiores fiunt ij motus, quos explicauimus. Dorsum vt non osse vnico conditum est, ita neque id vnicus vtrinque musculus à capite ad os sacrum excurrere mouere possit: sed cùm singulas seorsum vertebrae flecti oporteret, à singulis earum interuallis (primum si demis) singuli vtrinque musculi exierunt. Illorum fibrae obliquè ducuntur, vt pariter intentae dorsum eíusque vertebrae erigerent, aliàs ad posteriora, aliàs ad latera quoquo versum inflecterent. Quocirca exteriores à tergo vtrinque numerantur tres et viginti. Interiores verò qui spinam in pronum et priora incuruant, vtrinque duo, vnus à capite ductus per colli pérque thoracis quinque superiores vertebrae productus, oesophago comes assidet, alter lumbis insternitur, ab vltima thoracis vertebra pergens in os sacrum. Ventris inferioris abdomen musculi constituunt octo, duo quidem recti in longum proiecti, duo transuersi, quatuor obliqui. Sunt autem eo ordine contexti, vt à cute et adipe proximè duo sequantur ex obliquis, qui vtrinque à quarta et quinta costa nati, horúmque musculis pectinatim implexi, per ventrem obliquè feruntur membranosa tenuitate, ac denique arctiori extremo ossi pectinis applicantur. Recti hos sequuntur à quinta aut sexta costa supra malum punicum, directo tractu permeantes in pubem. His proximè subsunt reliqui duo obliqui, ex coxarum ossibus in aduersi lateris costas adulterinas euecti. Omnium infimi transuersi, vtrinque ab ilibus iuxta lumborum musculos externos orti, membranae specie ventrem integunt, dum in oppositam regionem desinant. Viro testiculus vterque binis fulcitur ab imo ventre prodeuntibus musculis: foeminae verò, quia testes intus ferit, vnico. Vesicae ceruicem musculus vnus ambit in orbem,

position. Seven muscles⁵² cover the top of the hand, all prominent on the internal surface: the two largest of these are the one under the thumb, and the one under the little finger, where the palm bulges more. They assist the tendons we mentioned, which particularly draw the fingers apart from each other. A third⁵³ lies between the thumb and index finger, and draws them together. The four remaining ones stick close to the roots of the fingers with fine cords and tendons that cause flexion, and send out thin fibers into the fingers, by which they turn them to a supine position. Besides these there are eleven small muscles under the broad thin palmar tendon. Two of these relate to the first joint of each finger. Of the remaining three, one relates to the first joint of the thumb and two to its second. By these links the movements we have discussed are strengthened and speeded.

Since the back does not consist of a single bone, no single muscle running from the head to the sacrum on either side can move it, but when it is required to move single vertebrae separately, single muscles have emerged on each side at each intervertebral interval (excepting the first). Their fibers run obliquely, so that when they strain equally they extend the back and its vertebrae, [but] sometimes bend it backwards and sometimes to the side in any direction. So those that are external seen from the back number twenty-three on each side. Those that are inside and bend the spine forward are two on each side: one runs from the head through the neck and the five upper thoracic vertebrae, closely accompanying the esophagus.⁵⁴ The other lies upon the lumbar vertebrae and runs from the lowest thoracic vertebra to the sacrum.⁵⁵ The abdomen [evidently the abdominal wall] of the lower belly consists of eight muscles: two recti running lengthwise, two running transversely, and four obliques. They are put together in the following order: two of the obliques lie closest to the skin and fat, and start on each side from the fourth and fifth ribs, interwoven in comblike fashion with the rib muscles, to run obliquely across the abdomen as membranous sheets and terminate in the narrower end of the pectinate bone. Next come the recti, from the fifth or sixth rib above the xiphoid process, running straight to the pubis. Immediately below them are the remaining two obliques, proceeding up from the hipbones to the false ribs that face them.⁵⁶ Most internal of all are the transversi, which start on each side from the iliac bones next the external lumbar muscles, and cover the abdominal cavity like a membrane, until they end in the opposite side.⁵⁷ In the male each testicle is supported by twin muscles emerging from the bottom of the abdominal cavity; but the female, because she carries her testicles inside, has only a single muscle. There is one muscle that runs right around the neck of the bladder, which is

cuius vis est exitum et quasi ostium occludere et vrinam continere: cùm autem fluere desierit, vehementer expellere ne quid insideat reliquiarum. In pene quatuor sunt, duo ad latera, qui intenti porum amplificant atque dilatant ad seminis effusionem: duo suprà ex pectinis osse nati, penem arrigunt impetùmque naturalem iuuant. Podicem quatuor omnino muscoli complent, vnus rotundus in orbem ductus, cuius est podicem coangustare, hunc igitur σφιγκτήρα dixere Graeci. Alius podicem in transuersum finit, illùmque sed quàm superior laxius constringit: duo obliquè supra rotundum vtrique euadunt, per quos laxatus podex sursum reuellitur. Iam verò qui femur mouent à coxendicis osse profecti, ossi femoris impinguntur, quorum alij crus extendunt, alij sursum adducunt, alij circumducunt. Ex his qui extendunt, vnus totum coxendicis articulum tegit parte posteriore, qui triplici capite enascitur, desinit autem in duos tendones affixos pòst femoris capiti. Alter post illum ab externis partibus ossis ilium, in summam partem magni τροχαντήρος immitur, qui exten-[P14] dit, intròque trahit caput femoris. Tertius post hunc ex eodem osse in trochantera magnum pertinet abditis partibus, qui modicè femur porrigit et conuoluit. Idem praestat et quartus, ab osse sacro in trochanteris posteriora demissus. Quintus omnium qui in toto corpore sunt maximus, os femoris vniuersum ambit, et ad genu vsque cingit: cuius complures extant fibrae, aliae posteriores à coxendice, aliae ab osse pectinis deriuatae: vtraeque dum articulum intendunt, crus stabiliunt atque firmant. Aliae his altiores femur intrò adducunt: omnium altissimae aliae idipsum ad priora superioráque conuellunt. Qui verò femur inflectere solent, minores sunt illis: vnus superior et rectus duobus capitibus exortus, ad parui trochanteris summa vnico tendone pertinens, alter illi proximè semper assidens, sed humilior. Tertius ex osse pectinis parte priore excidens, obliquè femori circumtensus, qui sursum ducit intrò simul declinans. Quartus ex tuberculo ossis ilium neruosa tenuitate in genu contendit, illius patellam conscendens: cuius est non solùm femur inflectere, sed et crus omne sursum afferre. Aliud est praeterea eorum musculorum genus, qui femur intrò mouent: in quo genere praeter alios duos, quos enumerans iam dixi à pectine deriuari, vnus est ab huius parte priore femori circumtensus desinènsque in genu caput interius. Circumducunt autem id duo maximè, vnus ortus ab occultis,

capable of shutting off the outlet to retain the urine, and, when the flow stops, of vigorously expelling any lingering residue. There are four muscles in the penis, of which two when they contract enlarge and widen the channel for the ejection of semen. Two others above arise from the pectinate bone and erect the penis, assisting its natural force. Four altogether make up the anus. One is a round ring that constricts it; hence the Greeks call it the sphincter. Another bounds the anus transversely, and constricts it, but not so tightly as the previous one. Two run out obliquely on either side above the round one, and pull up the anus when it has been slackened.

Now the muscles that start from the hipbone and move the femur are pressed against the femur; some extend the limb ["crus"], some draw it upwards, and some pull it around. Of those that extend it, one⁵⁸ covers the whole hip joint at the back, and arising by a triple head, ends in two tendons attached behind to the head of the femur. Another⁵⁹ originates behind it from the outer parts of the ilium, and is inserted into the top of the great trochanter; it extends and draws inward the head of the femur. [P14] Behind this is a third⁶⁰ from the same bone that reaches to the great trochanter in its deeply concealed parts, and extends and rotates the femur.⁶¹ A fourth as well [piriformis, probably] runs down from the sacrum to the back of the trochanter, and has the same function. A fifth is the largest muscle in the whole body,⁶² and surrounds the whole of the femur to the knee. It has a number of fibers, the back ones arising from the hipbone, and others from the pectinate bone. Both stretch out the joint and support and secure the limb ["crus"].

Some muscles lying more deeply draw the femur inward; others, the deepest of all, pull it forward and upward. The muscles that usually flex the femur are smaller than these: one arises higher up and straight by two heads, and is inserted by a single tendon into the top of the small trochanter;⁶³ another sticks close to it all the way, but lower down. A third [sartorius] emerges from the front part of the pectinate bone, and winds obliquely around the femur, which it draws up and at the same time turns inwards. A fourth [rectus femoris] starts from a tubercle of the ilium, reaches the knee by a thin tendon, and runs over the patella; it not only flexes the hip, but draws the whole limb upward.

There is also another group of these muscles, those that move the femur inward; I have listed two of these already, which I said originated from the pectinate bone, and besides there is one [evidently an adductor muscle] from the front of that bone wrapped round the femur, and terminating in the inner head of the knee. Two muscles draw it around particularly strongly, one originating from the hidden parts [perhaps obturator internus] and one [perhaps

alter à summis partibus pectinis, qui coeunt ad coxendicem, illámque circum-
plicant, in femoris demum posteriora apud magnum trochantera pertinent.
Eundem motum, licet infirmius, efficere valent quidam ex his, quos paulò antè
recensebam. Femur integunt et obuallant ij, quorum tendones ad crus profecti
mouent illud: sunt autem numero decem, tres maximi parte priore positi rectà
ad genu progressi, vnus quidem ad patellam duntaxat, duo reliqui in vnum
tendonem amplum desinentes, qui patellam continet illigátque subditis ossibus,
hinc autem in crus deuolutus totum extendit trahítque sursum. Illis vtrínque
astat vnus, hic quidem interior ex ossium pectinis commissura pergens in cruris
latus: hic verò exterior ab extremis partibus coxendicis in alterum cruris latus
concedit: horum obliqua est motio. Medium inter hos spacium à tergo implent
alij tres ordine positi, quorum ad tibiam ductae propagines, illam subducunt in
suam quisque regionem. Nonus angustus et procerus ex ilium osse prodit, in
poplitis eminentiorem partem ductus insertúsque tibiae capiti, quam prorsum
explicat.¹⁴ Decimus omnium minimus, qui in poplite situs genu inflectit. In
crure musculi oriuntur, qui pedis tarsum pediúmque¹⁵ mouent. Tres prior pars
continet, vnum tibiae osse impositum, ex quo tendo bipartitus exit, ad pedis
pollicem vtrínque ductus. Alterum surae circumuolutum, cuius tendo in mini-
mi digiti radicem abit. Hi sunt qui aequè intenti pedem sursum mouent: altero
verò actionem obeunte, motus in obliquum torquetur. Inter illos medius insistit
alius minor, qui per mediam tibiam rectà ad quatuor fertur digitos, hósque
contractus extendit. Huic vtrínque vnus assidet trifariam diuulsus. Quocirca
tametsi praecipui tres sunt, collatis tamen omnium propaginibus atque vsibus,
sex aut septem rectiùs numerari possunt. Parte autem posteriore tres in mag-
num tendonem desinunt eum, qui ad calcem primùm pertinet, sed hinc demum
excedens in omnem plantae cuticulam disseminatur, perinde vt qui in manus
palma dicebatur. Quartus per profundum deductus, in eam regionem se profert,
quae ante pollicem est. Quintus sub illis demersus ad calcem effunditur, qui
deinde toti inferae pedis regioni communicatur,

the gemelli] from the superficial parts of the pectinate bone; they unite at the hip joint, wind around it, and finally extend to the back of the femur around the great trochanter. Some of the muscles I was describing a little earlier can produce the same movement, though more weakly.

The femur is covered and surrounded by the muscles that have tendons that make for the leg and move it. They are ten in number; the three largest ones lie in front and pass straight to the knee, one [rectus femoris] just to the patella, and the two others [vastus medialis and vastus lateralis] ending in one substantial tendon that encloses the patella and binds it to the underlying bones, and hence getting down to the leg extends it all and draws it upward. Beside them on both sides there is one [probably biceps femoris] of which the inner part starts toward the side of the leg from the junction of the pectinate bones, while its outer part [biceps femoris?] proceeds from the margins of the hipbone into the other side of the leg; these two act obliquely. The space at the back between these is occupied by three other muscles⁶⁴ arranged in order, which have branches proceeding to the tibia and pull it up, each to its own section. The ninth [probably gracilis] is long and narrow, and starts from the ilium to run to the most prominent part of the knee and be inserted into the head of the tibia, which it completely enfolds. The tenth [popliteus] is the smallest of all, and lying within the popliteal space it flexes the knee.

Muscles arise in the leg that move the ankle and the instep. The front part of the leg contains three: one [extensor hallucis longus] lying on the tibia, which gives off a double tendon, running to the big toe on each side.⁶⁵ Another runs round the calf, and its tendon ends in the root of the little toe [peroneus tertius?]. When they act equally these move the foot upwards, but one or other acting alone twists the movement obliquely. There is a third smaller one [extensor digitorum longus] between these two, which runs straight along the tibia to the four toes, and its contraction extends them. Beside this one on each side is a muscle split into three.⁶⁶ Though there are three notable muscles here, by putting together the branches and functions of all of them we can more correctly count six or seven.⁶⁷

In the back part [of the leg] there are three [two heads of gastrocnemius, and soleus] that end in the great tendon [Achilles tendon] that reaches the os calcis first and then extends beyond it to be distributed into the whole skin of the sole,⁶⁸ just as was described for the palm of the hand. A fourth [flexor hallucis longus] passes through the depths to present itself in the region in front of the big toe. A fifth [flexor digitorum longus] is sunk beneath these and spreads to the os calcis, thereafter reaching the whole lower region of the foot,

maximè verò medio digito, et ei qui pollici est proximus. Sextus inter cruris ossa consertus, duplici tendone tamquam loro ad duos qui superant digitos proferitur. Hi duo posteriores pedis articulos inflectunt. Praeter hos tamen in eundem vsum alij sunt in pede siti, quibus tria motus genera data sunt. In pedio enim quod metacarpio manus proportionem respondet, decem numerantur, è quibus singulis digitis bini per latera assident, qui pariter et aequè tensi illos aequaliter flectant, inaequaliter verò contracti illos intrò per obliquum ducant. In tarso qui ad carpi proportionem est, consistunt alij quatuor, quorum tendones in medios digitorum (praeter pollicem) articulos desinunt, illic et alij duo visuntur ad pollicem minimúmque inflectendum proiecti. Pedis pars superior decem gerit ad ra-[P15] dices digitorum positos, qui bini per cuiusque digiti latera affixi, illum possunt vel sursum aequaliter erigere, vel in alterutrum latus retorquere, prout varia fuerit illorum contentio.

*Quis usus partium interiorum, quarum beneficio viuimus et
nutrimur, quae illarum necessitas. Cap. VI.*

Quas suprà recensuimus corporis partes, satis esse viderentur ad omnes tum humanas, tum animales functiones obeundas, si in eis considerare posset et contineri illa vis animi omnia ciens et agitans motibus suis: pulchrúmque foret si ex illis duntaxat et cerebro constans homo, sentiret, moueretur, ac intelligeret, citra vllam viscerum et intestinorum opem. At verò quoniam sentiendi illa et mouendi facultas nequit sine vitali consistere, quae vt corpus omne tranans temperatione caloris omnia conseruat, ita principi alteri in cerebro positae tum sustinendae, tum functiones suas obiturae, spiritum suum velut materiam confert et impartit: idcirco cor velut principium gignendi spiritus induci commodum erat, ab eóque arterias produci, per quas spiritus in omne corpus diffunderetur: pulmonésque illi assidere, quorum esset mollitudo ad hauriendum spiritum aërmque aptissima: ipsum denique diaphragma et musculos thoraci circumiici, per quos dilatari contrahique possent. Porrò autem quoniam eorum et vniuersi corporis substantia, tum ab insito nobis calore, tum à circumfluo aëre aliisque causis assiduè dissipatur ac diffluit, neque diutiùs potest consistere, nisi idoneis alimentis resarciatur detrimenti dissolutionisque iactura: maxima fuit alentium partium commoditas, earúmque corpori iniecta necessitas.

but especially the middle toe, and the toe nearest the big toe. A sixth [probably tibialis posterior] fits between the leg bones and extends by a double tendon resembling a thong to the two remaining toes. These two muscles at the back flex the joints of the foot. In addition to these, there are others in the foot for the same purpose, provided with three kinds of movement: at the instep, which corresponds to the metacarpus in the hand, there are ten, of which two lie along the sides of each toe, and when they contract equally together they flex the toes evenly, but if they contract unequally they bend them obliquely inward. At the ankle, which corresponds to the wrist, there are four others [flexor digitorum brevis], with tendons ending in the middle joints of each toe (excepting the big toe), and two others are visible there that run out to flex the big toe and the little toe [probably abductor hallucis and abductor digiti minimi]. The higher part of the foot displays ten muscles lying at the roots of the toes, [P15] two attached to the sides of each toe, which they can either erect equally upwards, or twist to one side or the other, depending on their interaction.

Chapter 6. The function of the internal parts to which we owe our life and nutrition, and the need for them.

THE PARTS of the body discussed above would seem enough to carry out all human and all animal functions, if the mind's power that stirs everything up by its movements could be regarded as residing and contained within them. It would be a beautiful thing if a man consisting just of them and of a brain could feel, be moved, and understand, without any help from the internal organs and intestines. But the faculty of sensation and movement cannot exist without the vital faculty that pervades the whole body and preserves everything by the due proportion of its heat, as well as contributing its spirit like raw material to the other principle in the brain, for its maintenance and to let it perform its functions. So it was appropriate for the heart to be introduced as a principle for creating spirit; and for arteries to extend from it, along which the spirit could be distributed throughout the body; and for the lungs to rest upon it, to provide a yielding nature well suited for the uptake of spirit and air; and lastly for the diaphragm and muscles to be placed round the chest and enable it to be dilated and contracted [reading "posset"]. Further, their substance and that of the whole body is constantly dispersed and dissipated by the heat resident within us, by the surrounding air, and by other causes, and cannot last unless the loss by damage and dispersal is made good by suitable nourishment; therefore the advantage provided by the nourishing parts was very great, and a need for them

Itaque interiorum corporis tres omnino factae sunt regiones, propriis quasi sepimentis obuallatae: suprema in cerebro sensus rationisque sedes: media pectore comprehensa spiritus ac vitae domicilium: infima subter diaphragma et abdomen, naturae altricúmque partium officina. Ita enim immortalis Dei providentia hasce partes sordibus inquinatas atque foedas, in locum imum velut in sentinam corporis relegauit, procúlque amandauit, ne tetrís nidoribus cor et cerebrum principum facultatum sedes atque sensus ipsos contaminarent conturbarentque. Hic enim locus habetur veluti regiarum culina, in qua partes quaedam tanquam coci alimenta instruunt, caeterisque praeparant, quarum sunt ministerio destinatae. Inter illas princeps est iecur, cui ventriculus subministrat cibum ex parte coctum: alij ministri complures illorum eluuiem culina excludunt, viae tandem multiplices, per quas tum fiat eductio, tum purioris alimenti distributio. Oesophagus enim à linguae radicibus in ventriculum illapsus, quaecunque accepta sunt illi suppeditat: concoquit autem hic parátque iecori: intestina genitas concoctione cibi reliquias deiciunt: quicquid purius est iecori suggerunt venae quae dicuntur mesaraicae, vt hoc rursum altera coctione in sanguinem iecur conuertat. Hinc orta genitáque superuacanea in diuersa rapiuntur. Lienis siquidem id deducit sibique iungit, quod in sanguine velut faex et limus subsidebat: fellis folliculus secretam bilem: renes dilutum humorem, quem demum in vesicam profundunt. In haec autem opera vias ductas habent et directas, quae in se ex iecore pertinent, sibique adhaerent. Tot igitur talésque partes, vti et eas quae generis propagationi dicatae sunt et nuncupatae, par erat imo ventre comprehensas teneri: quae tametsi peculiarem sibi actionem singulae obtinent, hanc tamen ad communem referunt iecoris commoditatem et vsum. Iecur autem ad cordis, ambo ad cerebri necessitatem: omnia denique ad sensuum mobiliúmque partium gestiones et opportunitates, vt videri possit eximius partium omnium concentus, et in vnám summámque animalem actionem concors omnium conspiratio. Quinetiam partes illae cùm minimè simplices sint, sed aliarum certo numero constent, propriáque substantia, magnitudine, conformatione, situ, nexu atque consensu: his singulis quandam adhibent commoditatem toti, cuius gratia aut redditur illius actio concinnior, aut illaesa integráque conseruatur. Horum enim nihil temerè conditum est, sed cuiusque instrumenti propria functione

was created in the body. And so three regions of the body in all were made, fenced off, so to speak, by their own boundaries: the top one in the brain is the seat of sensation and reason; the middle one in the chest is the abode of spirit and life; the lowest one below the diaphragm and abdomen is the workplace of nature and of the cherishing parts. In this way these parts that are soiled and fouled by filth have been banished by the providence of immortal God to the lowest position, the sump as it were of the body, and their removal to a distance prevents unpleasant vapors from contaminating and disturbing the heart and brain, the seats of the main faculties and the senses themselves. This neighborhood is, so to speak, the palace kitchen, where some parts prepare foods like cooks, and get them ready for other parts that they are appointed to serve. Of these the main one is the liver, which is supplied with food partly processed by the stomach. A number of others serve by getting their waste out of the kitchen, and finally there are manifold paths along which this removal and the distribution of the purified nourishment can take place.

The esophagus runs down from the roots of the tongue to the stomach, and conveys to it whatever it receives. The stomach processes ["concoquit"] it for the liver's requirements. The intestines carry down the residue created by the processing of the food; the purer part of the food is conveyed to the liver by the veins named mesaraic, so that the liver can make it into blood by another further processing. Surpluses generated here are carried away in various directions: the spleen⁶⁹ removes and attaches to itself the part that kept sinking in the blood like sediment and sludge; the gallbladder does the same with separated bile; the kidneys do the same with dilute humor, which they finally release into the bladder. For those tasks they have channels from the liver leading straight into them and sticking together. It was right for the lower belly to hold within it this number and kind of parts, as well as those that are devoted to the propagation of the race and named accordingly. Although they each have their own particular action, they contribute it to the benefit and use of the liver. The liver serves the need of the heart, and both serve that of the brain. Ultimately everything serves the actions and advantages of the senses and the parts that can move, so that an extraordinary unanimity of all the parts can be seen, and a harmonious collaboration of everything towards a single very lofty living action. In addition, these parts are far from simple, consisting of a definite number of other parts, with their own substance, size, shape, position, linkage, and harmony; by each of these they contribute a certain fitness to the whole, which keeps its operation undamaged or makes it more elegant. None of them is produced casually, but when the particular function of each instrument is

perspecta, nul-[P16] lo negotio quid illa conferant deprehendi poterit. Quoniam igitur non functiones vsusque partium hoc loco, sed meram corporis historiam persequimur, haec ad pleniorum partium dinumerationem praefati, sigillatim explanemus quam quaeque corporis pars interior substantiam, quam particularum suarum compositionem, quam figuram et conformationem, quam magnitudinem, quem situm atque consensum ad actiones aptum obtinuerit.

De partibus interioribus infero ventre conclusis. Cap. VII.

Ventrem externa circumscriptio comprehendit et metitur, quae ab ima mali punici parte, vtrunque per cartilaginosa costarum extrema (hypochondria Graeci vocant, nos praecordia) ad ilia et inguina tandemque ad pubem porrigitur. Quod extrinsecus illum integit atque abdit, id vniuersum abdomen perhibemus, Graeci ἐπιγάστριον, cute, adipe, musculis octo et peritoneo compactum. Omnes enim musculos quales suo loco diximus, succingit interior membrana peritoneos inde dicta, quod à spina vtrunque emergens vmbilico prioribusque ventris partibus, ipsi denique diaphragmati et pubi connexa, quaecunque venter inferior continet, tensa illa prensat atque circumsepiat. Quamquam enim tenuis, firmissima tamen multum roboris et virium habet, ne intestinorum pondus sustinens atque coercens, diuulsa facile disrumpatur: mollis simul illa ut quodammodo laxari possit, dum venter quauis de causa turgescit. Duabus membranis continetur, quae ad posteriora cernuntur iuxta spinam conspicuè separatae: parte autem ventris priore vsque adeò cohaerentes et implicatae, ut una eademque censeatur. In ventris autem detecta capacitate primum conspicitur omentum, quod Graeci ἐπίπλοον dixere, quod veluti innatet, summumque intestinis insideat. Duabus id clauditur ex peritoneo natis membranulis, firmo adipe conspersis, quem venae et arteriae exiles passim penetrant. Prima illi origo iuxta spinam est sub diaphragmate, unde surgens altero quasi extremo in ventriculi fundum defigitur, à quo mox delabatur ventrem imum contegens, hincque reflexum colo intestino committitur, quia id ventriculum contegit, ut sic duplicatum veram marsupij speciem exhibeat. Obtensum autem imo ventriculo et priori intestinorum regioni, tanquam tegmentum quoddam, insitum in illis calorem tuetur ac fouet. Omento detracto desectoque in apertum proferuntur intestina, multis inuolucris ventriculo, huiusque continuata stomacho. Singularis enim in ventrem inferiorem communis patet per os ingressus, exitusque communis per podicem, quae quasi portae duae continuatione communis viae consentiunt.

perceived, what they contribute will be readily grasped. [P16] So since we are not here seeking the functions and uses of the parts, but a straight account of the body, after this prelude towards a fuller reckoning of the parts, let us set out one by one what substance, composition of its small parts, figure and conformation, size, position, and harmony suited to its actions each internal part of the body will possess.

Chapter 7. The internal parts held within the lower belly.

AN OUTER boundary embraces and delimits the belly that starts from the bottom of the xiphoid process, and passing through the ends of the costal cartilages (named hypochondria by the Greeks and precordia by us) extends to reach the loins and groins and finally the pubic bone. We call its whole outer covering the abdomen, the Greeks call it the epigastrium, and it is constructed from skin, fat, eight muscles and peritoneum. All the muscles that we described in their section are undergirded by the internal peritoneal membrane, so called because it issues from the spine on each side and is linked to the navel and the front parts of the belly, and finally to the diaphragm itself and the pubis, and it tightly grasps and encloses all that the lower belly holds. Though thin, it is very powerful and possesses much strength, to prevent its ready disruption as it supports and holds in the weight of the intestines. At the same time it is yielding enough to give to some extent when the belly swells for any reason. It comprises two membranes that are visible as obviously separate at the back by the spine. But in the front of the belly they are so united as to seem one and the same. When the belly cavity is opened, first the omentum is seen, which the Greeks called epiploon, because, so to speak, it floats on top of the intestines. It is held in by two small membranes derived from the peritoneum, which are sprinkled with firm fat and pierced everywhere by slender arteries and veins. It starts beside the spine below the diaphragm, and rising from there is anchored at its other end to the fundus of the stomach, from where it descends directly to cover the lowest part of the belly. It folds back from there to join the colon where the colon covers the stomach, so that it is doubled and genuinely resembles a pouch. Stretched as it is over the stomach and the front of the intestines, it guards and nurtures the heat resident in them like a cover. When the omentum is pulled and cut away, the intestines present themselves, connected by numerous wrappings to the stomach and to its gullet. The one general entrance to the lower belly is through the mouth, and the general exit is through the anus; these two combine to serve as doors for the general through

Quandoquidem ab ore in ventriculum stomachus prolabitur, quem aliter Graeci οἰσόφαγον, nos gulam appellamus: is velut intestinum quoddam procerus figura, per ceruicis interiora deuolutus, μόχque sub pulmones demersus in quinta dorsi vertebra considit. Hinc paulum exurgens mox vt se erexit diaphragma penetrat, atque demum summo ventriculò à laeua committitur. Vnde videri possit oesophagus ceu via quaedam esculentis potulentisque deuorandis ad ventriculum directa: hic autem velut commune receptaculum et prima concoctionis officina. In eum quippe vsum ampla huic intus est capacitas, simulque figurae species rotunda et globosa, vt in se plurima concluderet et amplexaretur, at nihilominus ob ductuum et canalium insertionem in modicam longitudinem se diffundit. Positus est sub septo transuerso, et à malo punico initium ducit medio corporis spacio, nisi quòd leuiter in sinistram deflectit, huc enim maximè superior eius pars contorquetur, inferior autem magis in dextram. Posterior pars vniuersa spinae insidet, cum qua ad primam lumborum vertebra cohaerescit: os verò quod veteres cor appellare consueuerunt, non illi, sed diaphragmati veluti pendens et sublatum affigitur. Neque verò illis duntaxat, sed omnibus denique circumsedentibus partibus nexu atque consensu iunctus est iocineri, lienì, intestinis, cordi et cerebro, idque membranarum, venarum, arteriarum, aut neruorum communione et interiectu. Ab ima eius parte qua ad dextram sub iocineris fibras in profundum se abstrusit et abdidit, [Pr7] exitus est ad intestina, πυλωρός dictus, quòd prolabantia è ventriculo alimenta tanquam ianitor cohibeat. Hunc autem parte superiore arctiorem natura condidit, quòd dura nec planè contrita famelici plerunque demittimus: at è ventriculo nihil excidit, nihil elabitur quod non exquisitè (siquidem id potuit) perfractum sit et comminutum. Duo intus glandulosa tubercula πυλωρῷ assistunt, quae dum applicant sese propiùsque admovent, viam exitumque claudunt, reserant verò dum relaxata se abducunt atque diuellunt, non nutu quidem et arbitrio nostro, sed naturali duntaxat impulsione. Hinc exordium capiunt intestina flexuosis gyris circumiectique longissima, extremo continuata podici. Exportandis purgandisque faecibus condita quidem sunt: at tantam tótque gyris implicitam circunductionem natura ad absolutae distributionis munus accommodauit, ne alimentum confestim elabens, gulae insaturabilique abdomini nos subiugaret, et ne sordido deiiciendi crebriùs ministerio indignae hominis dignitate seruituti nos manciparet. Itaque in tanta viae longitudine vix vlla potest alimenti portio foras elabi, quae non antè cuipiam sugentium venarum ori se applicuerit, vt inde quicquid vtile est et alendo corpori idoneum, rapiatur in iecur.

route. The gullet runs down from the mouth into the stomach; the Greeks use the alternative name esophagus for it, and we call it “gula.” It has a long outline like an intestine, and presently passes through the interior of the neck to lie under the lungs and to rest upon the fifth dorsal vertebra. Pushing forward a little from there it has soon straightened up and pierces the diaphragm, and finally enters the top of the stomach from the left. Thus the esophagus can be seen as a straight path to the stomach for the food and drink that have been consumed. The stomach in turn is a general reservoir and the first workshop for concoction. In fact it has a generous internal capacity for this purpose, and also a rounded globular shape, enabling it to enclose a great deal within itself, yet because of the channels entering it, it extends over a limited length. It is situated below the diaphragm, and starts from the xiphoid cartilage in the central space of the body, except for a slight deviation to the left, involving especially its upper part; the lower part deviates more to the right. The whole of its back lies on the spine, and is attached there to the first lumbar vertebra; but the orifice that the ancients used to call the “heart”⁷⁰ is not so attached, but hangs from and is attached to the diaphragm. It [i.e., the stomach] is linked by a bond of sympathy not just to the structures mentioned, but ultimately to all the surrounding parts: the liver, spleen, intestines, heart, and brain; and this is by sharing and interposition of membranes, veins, arteries or nerves. From its lowest part, by which it has retreated into the depths on the right below the lobes⁷¹ of the liver, [P17] there is the way out to the intestines, which is named the pylorus because it serves as a doorkeeper to control the food emerging from the stomach. Nature has made it narrower in its upper part, because when we are starving we generally send down hard material not completely ground up, but nothing escapes from the stomach except what is so far as possible finely milled. There are two glandular swellings inside at the pylorus, and when they join and move closer together they block the exit, but open it by drawing apart when they relax. This occurs not by our consent and decision, but just by a natural impulse. From here the great length of the intestines with their twists and turns takes its start, all the way to the anus at the end. They are fashioned, it is true, for conveying and getting rid of feces, but nature has adapted their long circuit with its many coils to perform a complete distribution, so that food could not slip through quickly and enslave us to a ravenous gullet and abdomen, or put us at the mercy of an ugly inhuman need to relieve ourselves too often. The pathway being so long, virtually no part of the food can emerge before having come in contact with the mouth of one of the absorbing veins, so that anything of use and suitable for the body’s nutrition is carried off to the liver.

Omnium porrò intestinorum vnus est continuúsque ductus, vnus et idem vsus, vt proinde vnum videri possint, nisi figura, magnitudo, substantia, sitúsque ea disiungeret: quamobrem senario sunt numero veteribus comprehensa. Quod protinus ab ima ventriculi parte enascitur omnium arcissimum, ἔκφυσις id est exortus dicitur, duodecim digitos longum, nullis intortum anfractibus, rectà sub iecur et venam portam se recondit. Proximum illi ieiunum, inde nomen habens, quòd inane perpetuò videtur: nulla enim cunctatione extrudit quaecunque accepit, affluentis in se bilis acrimonia lacessitum. Id modicè inuolutum ad spinam ex dextris retorquetur, longius quàm duodenum et laxius. Tertium εἰλεὼν quod ilibus nomen dedit, tenue quidem et exile, sed tamen maximum ex omnibus et longissimum, in orbes plurimos atque anfractus actum indéque nomen sortitum quasi flexuosum multisque gyris conuolutum, quod subter umbiculus [*sic*] ad ilia et coxas vtrinque positum eminentiores totius ventris regiones occupat, è quo plurima sit alimenti in iecur distributio. Quartum est caecum, à quo alui faeces speciem primùm et nomen habent:¹⁶ ab alimentis siquidem dum per tenuia intestina ferebantur, sucta est et allecta purior vtiliórque substantia, reliquiae verò superuacuae sunt faeces: quod nomen tum primum his inditur, cùm ad hoc intestinum peruenerint. Caecum idcirco dixêre, quòd egressui introitum aduersum non acceperit, sed hos vicinos adeò vt plerumque in vnum coire videantur: figura enim paruum aliquem oblongúmque ventrem repraesentans, reni dextro secundum coxam insidet.¹⁷ Hinc sequitur κῶλον, quod per iecoris caua primùm obrepit, vbi folliculum bilis attingens illíque nonnunquam annexum, amarorem colorémque luteum contrahit: inde paulùm exurgens ventriculi fundo insternitur: hinc ad sinistrum hypochondrium contendens, lienì accumbit: mox in posteriora demergitur cohaerétque reni sinistro, à quo demum laxius apud coxam sinistram eminet. Sextum inde postremúmque in os sacrum deuoluitur, rectáque pergit in podicem: vnde rectum appellatur intestinum, plerisque aluus. Vnum cōlon praeter caetera plurimis quasi cellulis discretum extumescit, nisi qua parte sinistro reni assidet: hìc enim laeue conspicitur, et multo angustius se ipso factum: quod vt in coxam sinistram sese extulit, à recto intestino angustia quadam velut strictim premente vinculo facta, perspicuè diiungitur. In cōlo faeces diutiùs commoratae, vel potiùs ex viae anfractibus haerentes, effigie sua conformantur: deinde verò elapsae, in aluo capaciore, quemadmodum vrina in vesica, tantisper retinentur,

The intestines as a whole are one unbroken passage, with one and the same function, so that they can be regarded as a unity except for the distinctions of shape, size, substance, and position. Hence the ancients treated them as six items. The narrowest of all starts directly from the end of the stomach, and is named *ecphysis* or outgrowth, twelve fingers long, free from tortuosities, and concealed directly below the liver and the portal vein. Next to it is the *jejunum*, so named because it always appears empty; it promptly propels along all it receives, irritated by the pungency of the bile that flows into it. It is moderately twisted and bends back towards the spine from the right hand side, being longer and roomier than the *duodenum*. The third part is the *ileum* and it contributed the name to the loins [*“ilia,”* the lateral cavities below the ribs]. It is slender and thin, but is the largest and longest of all, coiled up into numerous curves; its name is derived from its many bends and loops, since it fills the higher parts of the whole belly behind⁷² the umbilicus on each side behind the *ilia* and hips. From it there is a very large transfer of nutriment into the liver.

The fourth part is the *caecum*, and from here the feces first acquire their form and their name, since the purer and more usable substance is sucked and coaxed out of the nutriment during transit through the small intestine, and what is left is the superfluous dregs, the name first used when they have reached this part of the intestine. It has been called the *caecum* because it has not been provided with an entrance opposite its exit, but the two adjoin so closely that mostly they seem to have become one. Its shape resembles a small oblong stomach, lying on the right kidney behind the hip. Next comes the *colon*, which begins by creeping up through the hollow of the liver, and touching the gallbladder there and being sometimes attached to it, picks up bitterness and a yellow color. From there it pushes out a little and is overlaid by the bottom⁷³ of the stomach. Making its way from there to the left hypochondrium, it lies on the spleen. Soon it sinks back and is attached to the right kidney; finally it projects from it more freely in the region of the left hip. The sixth and last part of the intestine runs down into the *sacrum*, and proceeds straight to the anus, so that it is called the *rectum*, and by most people the *bowel*. The *colon* alone, much more than the rest of the intestine, swells out through being divided by numerous pouches, except where it lies on the left kidney; there it has a smooth appearance and becomes much narrower than elsewhere. As it has been raised onto the left hip, it is clearly distinguished from the *rectum* by a narrowing like a bond, closely constricting it. In the *colon* the feces pass more slowly, or rather are held up by the bends in the channel, and acquire their shape. Then they leave it and are kept for a time in the larger *rectum*, like urine in the bladder,

dum laxato musculo qui podicem ambit atque intercludit, illas iubemur extrudere. His paucis liceat, gulae, ventriculi, et intestinorum vsum, figuram, magnitudinem, atque situm deprehendere: compositionem verò seu partium numerum et substantiam, ita in singulis inuestigemus. Gulam ventriculum intestinâque omnia duplex tunica cingit atque componit: quarum interior nerui et membranae, externa carnis potius est aemula. Illius fibrae è ventriculo in rectum et longitudinem porrectae, ad ipsam quoque gulam pertinent, vt ventriculo gulae, totîque ori interior tunica communis censi possit. Externa tum ventriculi tum gulae in transuersum fila producit, sed ea in ventriculo corporea magis atque carnosae, in gula membra-[Pr8] nosa et neruosa. Medio inter eas tunicas spacio vnus ventriculus inspersa gerit variè intexta fila, quae in obliquum effusa ipsi gulae omnino desunt. Caeterum vtrique in intestinis villos suos profert transuersos et in orbem actos, reliquorum autem illic prorsus nullus inest. Si qua insuper videtur extima tunica has extrinsecus obducere et ambire, quae subditos eòsque transuersos villos simul committat, ea sanè non propriae harum substantiae, sed peritonaeo accepta referri debet, è quo reliqua quoque viscera ambientes tunicas communiter acceperunt. Hinc colligendum videtur, gulam in ventriculi partibus numerandam esse, intestina verò minimè: sed haec ventriculo connecti, nequaquam ab eo nasci et exoriri. Superiora intestina quae tria esse prodidimus, prorsus sunt membranosa, inferiorum tunica interior multa carne praedita est, quam insuper adeps intus oblinet copiosus, vt eius beneficio ocyùs [*sic*] in procliuè quasi per lubricum praecipitentur alui reiectanea. Hic autem omnium intestinorum cùm sit communis, in crassis tamen quàm tenuibus inest multò densior atque cumulator. Intestinorum omnium communis est per μεσεντέριον, quod et μεσάραιον dicitur, copulatio, quo velut proprio vinculo lumborum illa vertebrae annectuntur. Ex his enim mesenterium primam originem duxisse videri potest, eisque per lumborum et ossis sacri longitudinem adusque podicis extremum cohaerere: ibi enim acceptis à peritonaeo membranarum productionibus sese mox latiùs explicat, vt demum crebris flexuosisque marginibus quasi implicata intestina adhaerescant. Semper autem geminae excurrunt membranarum productiones, dùmque ad deuincienda intestina progressae mesenterium componunt, tutò inter eas consertae sunt venae frequentes, ab intestinis tanquam viae in portas iocineris directae, quas proinde

until by relaxing the muscle that surrounds and occludes the anus, we are required to expel them. This short account may convey the use, shape, size, and position of the esophagus, stomach, and intestines. But for each of these we will inquire into the composition or number of parts and into the substance, as follows. A double coat surrounds and holds together the esophagus, the stomach and all the intestines. Its inner part resembles nerve and membrane, but its outer part flesh, rather. Its fibers run straight and longitudinally from the stomach, and extend to the esophagus too, so that the stomach, esophagus, and whole mouth can be reckoned to have an interior coat in common. The outer coat of stomach and esophagus extends fibers transversely, but those in the stomach are predominantly fleshy, and those in the esophagus membranous and nervous. [P18] The stomach, and the stomach alone, possesses threads scattered within the interval between these coats, and interlaced in various ways, that run out obliquely and are entirely lacking in the esophagus. But in the intestines each coat puts out its filaments transversely and as rings; none at all of the rest of the filaments [presumably longitudinal] is present there. Whatever additional outermost coat covers and surrounds these externally, uniting together the underlying transverse fibers, ought certainly not to be regarded as associated with their own substance, but with the peritoneum, from which the remaining organs have together acquired their enveloping coats. Hence the conclusion seems to be that the esophagus should be reckoned a part of the stomach, but not the intestines at all; they are linked to the stomach, but do not originate from it. The upper intestines, which we recorded as three in number, are entirely membranous, but the lower intestines have an internal coat rich in flesh, with in addition a generous internal lining of fat, which enables the residues of the bowel to be propelled more quickly down what may be called a slippery slope. Although this coat is common to all the intestines, it is much more compact and complete in the thick intestines than in the thin ones. All the intestines have a common connection called the mesentery and the mesaraion, linking them like a special bond to the lumbar vertebrae, from which the mesentery can be seen to have taken its ultimate origin, clinging to them through the length of the loins and the sacrum right to the end of the anus. There it receives membranous extensions from the peritoneum and soon spreads out more widely, so that in the end the intestines stick together in the folds of numerous winding borders. The membranous extensions that go forth are always twin, and in proceeding to make up a mesentery to secure the intestines, enclose securely between themselves a crowd of veins, like paths from the intestines making for the gates of the liver, and called accordingly

mesaraeas et mesaraïcas appellant. Intexuntur his et arteriae complures ab Aortae trunco qui lumbis accubat, ad intestina diffusae. Sparguntur illuc quoque multi neruorum quasi surculi, quos sexta cerebri coniugatio promittit. Media inter vasa neruósque spacia adeps occupat atque implet: in hunc ad vasorum diremptus et diductiones, adenes, id est glandulae insistent, quae tum fissiones illas diuelli non sinant, tum intestina suo madore proluant. Itaque si à mesenterio vasa, neruos, et membranas demes, adipe glandulísque reliquum omne refertum conspicaberis. Supra mesaraeon primis lumborum vertebri insidet caro πάγκρεας appellata: plurimis scatet ea glandulis, quibus et sua mole venarum, arteriarum, neruorúmque tenues illic ramos sustentet ac fulciat. Diffunditur enim à septo transverso deorsum ad renes: vtrinque autem ad iocineris lienísque sedes. Duodenum intestinum atque ei per transversum innixam venam portam, huiúsque riuulos in ventriculum et lienem traiectos, tum denique arteriarum ductus et tubos neruorúmque tenuitates, quotquot illic sunt, amplexu illa firmo comprehendit. De his hactenus, nunc de iocinere caeterisque visceribus. Viae ab intestinis ad iecur ductae ac directae, venae illae quidem sunt mesaraïcae, quae illuc è ventre alimentum deuehant. Id enim primam et principem statuimus nutriendi officinam, quòd ingenita sibi facultate sanguinem efficiat proferátque: est enim ipsa illius actio Graecis αἱμάτωσις. Magnum id datum hominibus, praesertim helluonibus abdomini suo natis, subter quidem concauum, suprà et extrinsecus prominens, ferè in fibras quinque (Graeci λοβούς appellant) dissectum: quamuis conspectum à nobis est (nec rarò) solidum nullisque fibris diuulsum. Dextram corporis regionem sub septo transverso obsidet, ab eo digiti latitudine disiunctum, ne fortè obsesset illi quasi flabello praecordia ventilanti. Insidet autem leniter ventriculo, omnémque illius aeditiorem partem non modò dextram, verumetiam priorem fibris suis amplexatur. Ex septo transverso ex dextris praecordiis atque ex spina id pendet ac nititur, quibus atque ventriculo per medias membranas et venam cauam adhaerescit. Vix denique pars vlla corporis habetur, qua cum illi per venas aut arterias non intercedat communio. Membrana integitur tenuissima, in qua exilis neruus sensu praeditus è sexta cerebri coniugatione excidens absumitur: multis arteriis, sed quamplurimis venis, vt quarum initium est et origo, conspergitur, quas illius caro (παρέγχυμα Graeci vocant) stabilit atque firmat, propria quidem visceris substantia

mesaraeic veins. Interwoven with these are a number of arteries derived from the aortic trunk lying on the loins and distributed to the intestines. Numerous nerve branches are scattered there too, offshoots from the sixth cerebral pair [the vagi]. Fat fills out the spaces between the vessels and nerves, and in it glands [adenes] lie at the vascular branchings, preventing these splits from being torn open, and wetting the intestines with their moisture.⁷⁴ And so if you deprive the mesentery of its vessels, nerves, and membranes, you will find everything else full of fat and glands.

Above the mesentery on the uppermost lumbar vertebrae there lies flesh called the pancreas. It abounds in glands, with which (as well as by its own bulk) to support thin branches of veins, arteries, and nerves there. It spreads from the diaphragm down to the kidneys, and to the beds of the liver and spleen on each side. The duodenum, the portal vein that rests across the duodenum, its small streams passing over onto the stomach and spleen, and finally the arterial vessels and fine branches of nerves, all that are there, are held in its strong embrace.

So much for these matters; now pass on to the liver and the rest of the viscera. The pathways that lead from the intestines to the liver are those mesenteric veins, which convey nourishment from the gut ["ventre"] to that destination. We regard the liver as the primary and chief workshop for nutrition, because it creates and produces blood through its inbuilt faculty, an action the Greeks call haematosi. Men have a large liver, especially gluttons born to serve their stomach ["abdomini"], and it is concave underneath, but bulging above and externally, divided generally into five parts⁷⁵ that the Greeks call lobes. But when we have seen it, as we have often done, it has been solid and not broken up into lobes.⁷⁶ It occupies the right side of the body, below the diaphragm and separated from it by a finger's breadth, so as not to obstruct it as it fans the contents of the chest ["praecordia"]. It also lies gently upon the stomach, and its lobes embrace the stomach's more prominent part not only on the right but also anteriorly. It hangs and bears down from the diaphragm, the right chest's contents and the spine, and is attached through the intervening membranes and vena cava to these and to the stomach. To conclude: there is hardly a part of the body with which it is not interrelated through veins or arteries. It is covered by a very thin membrane, in which a slender nerve emanating from the sixth cerebral pair and endowed with the power of sensation terminates. Many arteries, but extremely numerous veins (it is their starting point and place of origin) scatter over it, and are made fast by its flesh, named parenchyma by the Greeks, which is the organ's particular substance and

atque moles, primúsque αἵματώσεως effector et author. Similitudinem autem gerit speciémque sanguinis [P19] ardore tosti, exhaustóque vapore daridi atque concreti. Ex iocineris porrò maiore saepius fibra bilis folliculus parte caua resimáque propendet, vesicula quidem ex simplici tunica constans, omni staminum genere intexta, expurgatae è iecore bilis flauae receptaculum. Duo enim bili ferendae ductus in illam pertinent, alter ex eo loco vbi vena porta iecur subit, quo bilem in se allicit: alter ad duodeni terminum ieiuínique initium, aliàs autem in ventriculi fundum proiectus, quo bilis exuperantia exigitur atque expellitur. Hac enim solent intestina ad faecum deiectionem quasi adhibito stimulo acui et irritari, ipsae autem faeces subflauo colore infici. Hanc vesiculam nonnunquam deprehendimus subnigris calculis iisque duris ac solidis confertam. Lienis parte sinistra sub praecordiis ex aduerso iocineris positus est, viámque veluti porum quendam ex illius cauo suscipit, qua crassam lutulentámque succorum eluuiem, et humores melancholicos prolectet et in se recondat. Figura is oblonga et propemodum tetragona, aliàs rotunda linguae bubulae speciem offert: quà ventriculum cingit concavus, extrinsecus intumescens. Non vna omnibus magnitudo, vt neque color vnus, sed facilè commutabilis ex naturarum varietate. Turgescit enim hoc viscus humorum appulsu, quos laxa raritate combibit. Perexiguum simiae ac propè nullum: visum est aliquando mole sua et magnitudine iecur superare, quod adhibitorum medicorum sententia existimatum est iecori ad sanguinis confectionem opitulari. Conditus est sub costas adulterinas, in longum ventriculo incumbit, cui sicut et omento connexus adhaerescit: appensus autem est conuexa parte non è septo vt iecur, sed è peritoneao gracilibus membranis, à quo tunica etiam hunc extrinsecus integens et obuelans emergit, quam exilis neruus permeat tractabilium qualitatum index et aestimator. Venae intrò se inferunt, per quas ex iecoris cauo succus ater quasi haustus allicitur: arteriae insuper plurimae et eae amplae, ab aorta mox vt è septo transuerso excidit acceptae, quarum spiritu et calore raptam melancholiam attenuat, et in vtile accommodatúmque sibi alimentum conuertit: eo enim enutritur tenui, nigro tamen et squalido. Quod à nutritione reliquum fecit, crassum quidem et vinaceae faecis aemulum, in os ventriculi per venae suae extremum eodem pertinens desinénsque profundit. His vasis diffusum circumiicitur lienis corpus, non id quidem caro simplex, sed παρέγχυμα rarum, molle, fungosum et solutum, excipiendis faecibus destinatum. Ad renes et vesicam ipsa nos rerum series iam accersit. In lumborum vertebrae ingens illa vena caua considit, quae à iocineris conuexo illuc prolapsa,

bulk, and the primary agent of haematosiſ. [P19] Its external form is that of blood baked by heat, and dried and hardened through loss of its steam. Further, the gallbladder hangs out as a rule from the larger lobe of the liver at a recess; it is a sac consisting of a simple coat of interwoven fibers of every sort, and holds the yellow bile excreted from the liver. Two ducts are associated with it to convey the bile: one from the point at which the portal vein runs under the liver, where it attracts the bile into itself, and the other running to where the duodenum ends and the jejunum starts, or in some cases running into the bottom of the stomach, where the overflow of bile is expelled. Bile normally pricks and stimulates the intestines like a goad, to make them deposit feces, and the feces themselves are stained yellowish. We sometimes find this bladder filled with blackish stones, which are hard and solid too. The spleen has a left side that faces the liver under the chest contents, and receives a channel like a kind of pore from its concavity, along which it attracts and stores away the thick muddy discharge of the juices, and the melancholic humors. It has an oblong and almost quadrangular shape, but in other cases is rounded and resembles an ox tongue; it is concave where it surrounds the stomach, but bulges on its outside. It is not of the same size or color in all cases, but can be readily altered through a variety of natural dispositions: it swells up at the approach of humors, which it laps up through the looseness of its texture. Apes have a very small spleen, almost none at all. The spleen sometimes seems of a greater bulk and size than the liver, because in the view of medical men who have been consulted it is considered as assisting the liver in producing blood. Its place is under the false ribs, it lies lengthwise on the stomach, to which it is attached as well as to the omentum. It hangs at its convex part, not from the diaphragm as the liver does, but from the peritoneum, by thin membranes, from which a coat develops that covers its exterior and is traversed by a slender nerve that indicates and assesses its manageable qualities. Veins make their way in, through which a dark juice is drawn from the liver's hollow as if it were a drink. There are also numerous substantial arteries, arising from the aorta just after it emerges from the diaphragm, and by the spirit and heat from them it thins the black bile it has acquired, rendering it into useful and appropriate aliment; what nourishes it is thin, but dark and dirty. What it has left over from its food is thick and like the sediment of wine; it pours it into the mouth of the stomach along the end of its vein that extends to its termination there. The body of the spleen enfolds and encloses these vessels; it is not simple flesh, but a loose parenchyma, soft, spongy, and friable, designed for the reception of dregs.

The very sequence of things now points us toward the kidneys and bladder. The great vena cava lies upon the lumbar vertebrae, falling there from the

mox deinde in femora et in omnes quae subiectae sunt partes velut in ramos sparsa diffunditur. Huic vtrunque accumbunt renes alliciendo è sanguine sero (οὔρον Graeci vocant, nos vrinam) accommodati. Positi sunt enim paulò infrà iecur, è quo id maximè deducunt, ac dexter laeue ferè altior est, quanquam aliquando is depressior comperitur. Incubant ambo musculis dorsi interioribus, quos ψόας Graeci dicunt, inanibus iis subiecti partibus, quae inter costarum extrema et os coxae interiectae sunt, κενεῶνες propterea Graecis appellatae. Inhaerent autem illis vincti tunica è peritoneo ducta, quae eos ipsos velat et contegit, sensum simul illis quendam obtusum impertita. Geminos quidem illos natura condidit, ne vno praepedito aut obturato, eius humoris cessaret profusio qui longè copiosissimus est in nobis. Visus est cui secundum naturam vnicus esset, sed qui quod numero diminutum fuerat, mira magnitudinis mole exaequaret compensarétque: gemini autem cùm habentur, minores eos esse optima ratio est. Quà venam cauam spectant sinuati sunt: extrinsecus ad ilia gibberi oblongi, et quasi in retusae lineae speciem curuati. Ne autem immodica laxitate exceptam vrinam sinerent fusiùs elabi, compacta densaque substantia firmati sunt, quam multus circumcirca concretus adeps inuoluit. Sua vtrique vena (emulgentem recentiores dixere) è proximis venae cauae sedibus deriuatur, in resimam partem inserta. Similis est arteriarum ex maiore quae lumbis est annexa propagatio: et vtrorúmque vasorum tenuiores rami, in renum substantiam dispersi oblitescunt. In medio concauus est sinus propria membrana succinctus, quae propriè incerniculum est percolandae vrinae: non enim cum multis existimandum est id in rene sinum medium dirimere, sed què renes dilutiorem sanguinem per venas emulgentes quasi suxerunt, [P20] in suam deinde substantiam recondunt vice alimenti: hinc quod planè aquam aut serum refert, in intimam capacitatem per incerniculi membranam colatum excidit, móxque per οὐρητήρας profunditur in vesicam. Sic enim appellant Graeci ductus et vias vrinae, qui ex reducta parte emergunt, et deorsum ad vesicam contendunt. Proceri ij quidem et valentes, qui tametsi simplici tunica vt venae praediti sunt (hinc plerisque venae albae nuncupantur) nihil tamen his cum emulgentibus communionis intercedit, nec vlla societate copulantur: sed vesicae prorsus sunt assimiles cuius propriam substantiam planè referunt. Protenduntur autem à renibus in coxarum regiones, vnde mox in vesicae latera retorquentur, eaque subeunt, non quidem directò sed oblique: membranam

convexity of the liver, and then soon breaks into branches and is distributed to the thighs and all the parts below. Beside it on each side lie the kidneys, which are suited to the extraction of serum from the blood (the Greeks call it *ouron*, we call it urine). They lie a little below the liver, from which they extract a great deal of it, and the right one is generally higher up than the left,⁷⁷ though sometimes lower. Both lie upon the internal muscles of the back, which the Greeks call *psoas*, and below the empty spaces between the rib ends and the hipbone, which the Greeks call *loins* because they are empty.⁷⁸ The kidneys are attached to them by a confining coat derived from the peritoneum, which covers them up and at the same time shares with them a blunted sort of sensibility. Nature formed them as a pair, in case when one were entangled or blocked, there was arrest of the outpouring of the humor that is the most plentiful in us. A case has been seen with a kidney naturally single, but it made up for what had been lost in number by its remarkably bulky size; when there are two, the best plan is for them to be smaller. They are hollowed out where they face the vena cava, but outside at the ilia they are humped and oblong, and curved to resemble a blunted line.⁷⁹ To prevent them permitting too liberal release of urine received through excessive slackness, they are reinforced with close-packed substance, wrapped all around with much firm fat. Each has its own vein (modern writers called it the *emulgent*⁸⁰ vein) derived from the closest points of the vena cava, and introduced into the recessed part. The arterial supply is similar, from the great artery adjoining the loins, and finer branches from both vessels ramify to become hidden in the substance of the kidneys. In the middle [of each kidney] there is a hollow cavity surrounded by a membrane of its own, a membrane that is precisely a sieve for straining the urine. It must not be supposed (though many do) that this sieve opens up a cavity in the middle of the kidney; the kidneys have, so to speak, sucked more dilute blood through the emulgent veins, and lay it up in their substance instead of aliment. [P20] Then the part that represents water or serum escapes into the internal cavity through the perforated membrane of the sieve, and presently pours out into the bladder via the ureters; this is what the Greek call the passages that emerge from the recessed part [of the kidney], and run down to the bladder. They are long and strong, and though they have a simple coat like veins (hence most people call them white veins), they have nothing in common and no association with the emulgents, but are entirely similar to the bladder and obviously resemble its particular substance. They extend from the kidneys to the neighborhood of the hips, and thence bend back soon into the walls of the bladder, which they traverse, not straight through but obliquely; they pierce

enim findunt, in quam (quasi ea duplex esset) sese medios insinuant, ne si directus pateret ingressus, qui in vesicae capacitatem inciderat humor, retrò compelli regerique facile posset. Itaque vrinae receptaculum est vesica, vbi tanquam in laguncula quadam ea asseruatur, dum ratio et arbitrium iubeat extrudere. Globosa illa quidem, quò fieret humoris capacior, sub os pectinis in coxarum antrum deiecta reconditur, recto intestino innexa affixaque. Haeret autem illi ipsique coxarum ossi membranarum interiectu, quas peritoneum expromit: ex eoque genere tunica illam extrà circumsepi, quam suprà monuimus omnium esse viscerum communem. Propria enim vesicae substantia simplex est membrana, sed quae triplici staminum genere contextitur. In hanc venae complures tendunt, per quas alimentum capessit: similiter et arteriae tenues quae illuc vitae spiritus effundant. Conspicui sunt et canalis vietus iam totus et emeritus οὐραχὸς Graecè dictus, è fundi tumentiore parte in vmbilicum surrectus: hoc olim dum vtero gestaretur infans, necdum pudendo meieret, vrina è vesicae capacitate in vmbilicum confertim [*sic*] redundabat. Ceruix qua vrinam reddimus particeps est carnis, vtpote musculo cincta quem suprà σφιγκτήρα diximus appellari, cuius est exitum intercludere, ne nolentibus nobis effluat vrina. Foeminae brevis est ceruix, mari productior, vt quae in extremum vsque penem porrigitur. Sequuntur nunc testes δίδυμοι Graecis dicti, quos inter prima gignendi instrumenta commemorant: quia in eis facultas insit σπερματική, id est seminalis. Substantia ij quidem molles et quam aptè glandulae assimilaueris, et in qua vis illa potissimùm considet. Albi sunt ij, figura oblongi, rotundi, et cauernosi: maribus extant atque eminent proprio inuolucro conclusi pendente ab inguinibus, huic scroto nomen est, Graecis ὄσχεον appellatur. Ductus tanquam tubi in hos pertinent (quidam vasa seminaria dixerunt) quorum planè dissimilis est exortus: dexter enim ex vena caua emergit paulum sub rene, laeuus autem è vena sinistra emulgente. Ab ortu lento longoque anfractu concedunt in ilia, geminis fulti tunicis: neque vt vrinae ductus lumbis innituntur et adhaerent, quippe qui extra peritoneum supra os pectinis sint emersuri. Sua vtrique comes est arteria, quae simili atque vas ipsum tum ortu, tum productione fertur, vt dextra ab arteria maiore statim erumpat, sinistra ab emulgente arteria. Assistunt illis et exiles neruorum propagines è sexta ea cerebri coniugatione, quae per

the membrane and worm their way into its middle as if it were double, so that humor that has entered the bladder cavity cannot readily be propelled and directed backwards, as would occur if an entry channel ran straight through. Thus the bladder is a store for urine, accumulating it like a kind of flask, until the reason and the will require its ejection. It is rounded, so as to hold more humor, and is hidden behind ["sub"] the pectinate bone, dropped down into the cavity of the hips and attached to the rectum. It adheres to it and to the hipbone itself through intervening membranes, which the peritoneum puts forth. A coat of that kind [i.e., presumably peritoneum] surrounds it outside, and as already mentioned is shared by all the viscera. The particular substance of the bladder is simple membrane, but woven from a threefold sort of threads. A number of veins make their way into it, and through them it takes up nutriment; similarly there are slender arteries that pour out the vital spirit there. Also obvious is a channel now completely shrunken and disused, called the urachus in Greek, running up from the more bulging part of the [bladder] fundus into the umbilicus. Earlier, while the babe was being carried in the womb and did not yet pass urine from its private parts, the urine used to overflow all together by this channel from the bladder cavity into the umbilicus. The [bladder] neck by which we pass urine has its share of flesh, being surrounded by a muscle that as mentioned above is named a sphincter; its task is to close the exit in case urine flows out against our will. The female has a short bladder neck, the male a longer one, since it extends right to the end of the penis.

Next come the testicles, called didymi by the Greeks, who mention them as among the main instruments of procreation, because in them the spermatic or seminal faculty resides. They are soft in their substance, which you might well compare to a gland, and in it especially that ability resides. They are white, oblong in shape, rounded, and cavernous.⁸¹ In the male they are a prominent feature, enclosed in their own sheath hanging from the groins called the scrotum, in Greek oscheon. They possess tubelike ducts⁸² (some people have called them seminal vessels) that have obviously different origins: the right one emerges from the vena cava a little below the kidney, but the left one from the left renal vein. From their origin they run in a long gradual bend down to the iliac region, reinforced by twin coats; because they are on their way to leave the peritoneum above the pectinate bone, they are not like the urinary channels that rest on and are attached to the loins. Each has its accompanying artery, which has an origin and course similar to the vessel itself, so that the right one bursts forth directly from the aorta, but the left from the emulgent artery.⁸³ Thin nerve branches adjoin them from that sixth cerebral pair, which runs down through

septum transuersum infrà procurrit. Haec itaque vasa mox ab origine sensim ad latera deflectunt, tum dein sustolluntur ad ilia et supra pectinem, in scrotum denique elabuntur per inguina, gemina peritonaei tunica nusquam non obuallata. Haec plerunque videas ad mediam vsque productionem puro synceróque conferta sanguine rubere, adèò vt venas esse iudices: vbi verò longiùs fuerunt progressa, albescit quicquid in eis concluditur, quasi rudimentum futuri seminis. Testium illa corpus intrò non subeunt, sed tenero id circumuectu amplectuntur super epididymida. Est autem ἐπιδιδυμὶς inuolucrum mollius, quod testiculo propter caput incumbens, mediam inter illum et vas seminarium sedem occupat. Ab eo quem dixi circumuectu, mox vasa ad os pectinis resiliunt atque reflectuntur, hínque quasi praecipitata in decliue coxarum spatium aguntur, dum ceruici vesicae vtrinque astent. Hanc demum comitantur adusque penis radicem, vbi in vnum eundémque canalem confluunt, qui ab vrinae ductu diuersus est: sed et hi quoque ambo dum pudendi medium attigerint eódem concurrunt, vt tandem extremo pene vnicus cernatur. Vasa haec per quae semen è testibus foras iaculamur, quanquam appellatis [P21] seminariis continuata sunt, nomen tamen commutarunt, dicuntúrque Graecis παραστάται, nobis quasi astites.¹⁸ Duplices itaque ductus testibus, vni latores, iaculatores alteri. Sed quò sit omnis horum progressio maioribus quasi theatri ante omnium oculos proposita et aperta, de eis et peritonaeo non alienum fuerit pauca rursus admonere, quae à veteribus praetermissa saepe dissectionibus indicaui. Peritonaeum vniuersum duplex est, cuiusvna tunica venae cauae, arteriae maiori, renibúsque substernitur: altera superior haec contegit omnia, vt vndique cincta suas quoque productiones omnes, geminas inter tunicas tutissimè mittant profundántque. Itaque exterior peritonaei tunica quam dixi renibus substerni, cùm ad os pubis iam propiùs accessit, in sese quasi reducta coactáque, velut canalem quendam efficit laxiorem, quò permeant ductus latores seminarij, remeántque iaculatores parastatae. Hinc deuoluitur in scrotum, vbi laxiùs se explicans, omnia illius interiora sublinat succingítque. Alteram peritonaei tunicam huic continuatam diceret parte ventris priore, adèò ei firmè adhaeret. Diuellitur autem atque distrahitur iuxta os pectinis, hoc enim ipsum ea non conscendit, sed ventris coërcita finibus, illius duntaxat interiora complectitur et ambit. Ex quo intelligi potest nusquam perforari peritonaeum, vt quodam veluti foramine ductus seminarij in scrotum illabantur, quae tamen Galeni reliquorúmque omnium est assertio: sed in omni enterocele

the diaphragm. And thus these vessels soon after their origin incline laterally little by little, then rise to the loins and over the pectinate bone, and finally run out through the groins into the scrotum, enclosed everywhere in a twin coat of peritoneum. Up to the middle of their course, they are generally seen full of pure red blood, so that you might take them for veins; but after proceeding further, their content whitens, as if it were the raw material of future semen. They do not make their way inside the body of the testicles, but hold it in a gentle embrace above the epididymis. The epididymis is a softish sheath, which lies on the testicle close to its head, and lies between it and the seminal vessel. From the embrace mentioned, vessels [vasa deferentia] soon spring back to the pectinate bone, and from there run steeply into the sloping space between the hips, until they adjoin the neck of the bladder on each side. They keep by it as far as the root of the penis, where they run together into one and the same channel, which is not the same as the urinary duct. But both combine on reaching the center of the private parts, so that ultimately at the end of the penis a single channel is found. These vessels through which we ejaculate semen from the testicles to the outside are continuous [P21] with what are called the seminal vessels, but have changed their name, and are called in Greek parastatai, by us, as it were, astites.⁸⁴ So the testicles have two ducts: the conveyers, and the ejaculators.⁸⁵ But to make their whole course open and obvious to all eyes, as if we were in larger theaters, it will turn out relevant to recapitulate a few details about them and about the peritoneum, which I mentioned had often been overlooked by the dissections of the past. The whole peritoneum is double: one coat is spread over the vena cava, aorta, and kidneys; the other lies above it and covers all these, so that being enclosed they can dispatch all their branches between the two coats in complete security. And so when the outer coat of the peritoneum, which I said lies over the kidneys, gets closer to the pubic bone, it is drawn up into itself and pulled together, and forms a sort of slackish channel, through which the conveying seminal ducts make their way out and the ejaculatory parastatai⁸⁶ make their way back in again.⁸⁷ From there it runs down into the scrotum, where it spreads itself out more loosely to line and undergird all its interior. You could call the other peritoneal coat in the front part of the belly a continuation of this one, it sticks so firmly to it. But it is drawn away from it close to the pectinate bone, since it does not climb over the bone, but remains within the bounds of the belly, and embraces and surrounds its internal parts only. From this it can be seen that there is no kind of hole anywhere in the peritoneum, where the seminal ducts can run down into the scrotum, though that is what Galen and all the rest say.⁸⁸ But in every enterocele⁸⁹ and

atque epiplooele, tunicam interiorem necessariò disrumpi, externam verò duntaxat laxari. Sed iam ad orationis contextum me refero, gignendi partes quales in foemina sint, enarraturus. Alterum instrumentum et tanquam nostrae procreationis hortus est vterus, qui propria legitimáque actione semen excipit, concipit, et fouet, eousque dum foetus absolutus consummatúsque fit. Virginibus quidem admodum exiguus: mulieribus etsi vterum [*sic*] gestauerunt, nisi vbi grauidae sunt, non multò maior quàm vt manu comprehendatur. Simplici tunica is continetur: sed ea crassa densáque et carnosa, quae omni valentium staminum genere intexta, latè cùm necessitas est possit explicari. Figura illi rotunda, nisi quòd ad ceruicem paulò sit longior, pyro maiusculo similis. Positus est in coxarum capacitate, quae mulieribus quàm viris est amplior, quippe quae infimo loco et quàm proximè os sacrum, claudere complectíque debuit rectum intestinum: super hoc verò vterum huícque insidentem vesicam, quae os pectinis iam attingit. Astringitur itaque nectitúrque vterus vesicae, atque recto intestino tenuibus ex peritoneao ductis appendiculis: similitérque coxarum ossibus validis, sed tamen laxis vinculis, quae ad illius cornua pertingunt. Sic enim appellarunt ingentes processus, qui curuatis inflexís cornibus assimiles, vtrinque ab vteri introitu sursum ad ilia coxarúmque ossa incuruati retorquentur. Horum in extremis fixi haerent mulieris testiculi, compressiores, minores, molliores et humidiores quàm maribus: vasis seminariis circumfunduntur, ab éisque cinguntur, quorum eadem atque in maribus est origo. Considerunt tamen in lumborum musculis, nec extra peritonei capacitatem excedunt, cùm nec ipsi testes extrà sint. Quocirca brevis illis est via, at non directa, sed pluribus gyris anfractibúsque flexuosa quàm maribus, vt viae breuitas flexuum multitudine compensaretur. A testibus per cornua iter est in vteri interiori sinum, per quod acriter contendit Galenus semen eodem intrudi et inferri. At qui nostra memoria viri celebres habiti sunt, alij vetustissimum Herophilum sequuti, è testium inuolucro iter esse censuerunt in neruosam vteri ceruicem, iuxta illius os interius: alij è testibus tum in ceruicem, tum in capacitatem vteri vias duci volunt, quorum ego sententiae subscribo. Venae arteriaéque plurimae sparsae diffunduntur in vteri corpus, quarum ortus ab iis tum venae, tum maioris arteriae ramis trahitur, qui vtrinque ad coxas et crura contendunt. Ab eis itaque alij riuuli in corpus vteri ad nutritionem oblitterantur, alij patente ostio exitúque in vteri sinus desinunt. Haec acetabula dicimus,

epiploocoele⁹⁰ the internal coat is necessarily ruptured, but the external one is simply slackened.

But now I return to the pattern of my discourse, and am going to describe the reproductive organs in the female. The womb is the other instrument and, so to speak, the garden, of our procreation. By its particular and regular action, it receives, conceives and cherishes the semen, to the point that the fetus becomes complete and perfect. It is quite small in virgins; in women, even if they have borne a child,⁹¹ it is not much bigger than can be held in the hand, except during pregnancy. A simple coat encloses it, but is thick and close-knit and fleshy, and being woven from every sort of strong threads, can expand greatly when necessary. Its shape is spherical, except that at the cervix it is slightly longer, like a biggish pear. It lies within the pelvic cavity, which is larger in women than in men, because at its bottom and closest to the sacrum it had to accommodate the rectum; above this the uterus, and on top of it the bladder, which is now in contact with the pectinate bone. The uterus is closely bound to the bladder, and by fine processes drawn out from the peritoneum to the rectum; likewise to the strong hipbones, but by slack links that extend to its horns. This is the name given to the large extensions that resemble curved horns and bend back curving inwards on each side from the uterine entrance up to the loins and hipbones. On their ends are fixed the female testicles, which are more compact and smaller, softer, and moister than those of males. They are enclosed and surrounded by the seminal vessels, which have the same origin as in the male, but rest on the lumbar muscles, and remain within the peritoneal cavity, as indeed do the testicles themselves. So their path is short, yet not straight, but bent in more numerous twists and loops than in the male, so that the short path is compensated by the number of bends. From the testicles there is a path through the horns into the interior of the uterus, along which Galen vigorously contends that the semen is squeezed into the uterus. However, of those who have been renowned within our own memory, some have followed Herophilus of distant antiquity, and have held that the path is from the testicular sheath into the nervous neck of the uterus, beside its internal mouth. Others prefer routes that run from the testicles both into the uterine neck and into the uterine cavity, and I agree with them. Very numerous veins and arteries are scattered widespread into the body of the uterus, and derive their origin from the branches of the vein [vena cava, evidently] and of the aorta that make for the hips and legs on each side. Similarly, some small channels from them terminate within the uterine body for its nutrition, and others finish with an orifice opening into the uterine recesses. We call these acetabula,⁹² and the

Graeci κοτυληδόνας per quae tum menstruus sanguis statis temporibus emanat, tum in praegnantibus alimentum foetui confertur: reliquo tempore conuiuent: maximè autem in angustum deducuntur iis, quae è vita excesserunt, vt nequaquam illa sensus internoscat. Quidam ex memoratis illis riuulis in extremam proferuntur vteri ceruicem, per quos menstruum virginibus aliquantum erumpit. Dissectus in longum vterus [P22] duos sinus promit dextrum ac sinistram, nullo septo discretos, inanes et admodum leues, angustos adeò vt fabam maiusculam vix capiant. Communis est ab iis via in os vteri, quod est arctissimum, eique glandi simile, quae in extremo est masculi genitalis. Ceruix id sequitur partim lacertis, partim membranis et nervis condita, ea longitudine vt foras in obscoenas mulieris partes desinat. Substernitur haec ceruici vesicae, eique per communem musculum penitus implicatur. Itaque foeminis tria extant foramina, supremum vesicae perangustum, medium vuluae, podicis infimum. Vteri ceruicem medio circiter progressu plerique tradunt in virginibus exili membrana dirimi venulis conspersa, quae primo concubitu profuso sanguine dirumpi solet, vnde ὑμὴν et ὑμέναιον Graecis appellatur: at potiùs censeo ceruicis latera nondum venerem expertis, duntaxat quasi conglutinata conuiuere, quae primus concubitus magna ex parte diuellit. Extrà in obscoenis vuluae est ostium cartilagosum, rugosis cuticulis implicatum, quae arcent ne aura frigidior intrò subeat: in cuius rimae medio interiacet muscosa caruncula, quae νύμφη Graecis et κλειτορίς appellatur virilis penis praeputio assimilanda. Quaecunque circa foetum solent in vtero nasci, cùm illius conformationem scrutabimur, cumulatè sumus tradituri. Quocirca satis videor omnem ventris inferioris descriptionem impleuisse.

De partibus vitalibus. Cap. VIII.

Medius in corpore venter cordi ac vitae destinatus est, vtpote cuius domicilium et sedes habetur: nam cordis gratia pulmones tanquam stragula creati sunt, qui illius feruorem frigidiore hausto spiritu temperent. Circumscribitur hic venter suprà iugulis seu clauibus, infrà diaphragmate, circumcirca dorso, costis atque pectore. Etenim διάφραγμα, quod nos cingulum et septum transversum appellamus, praeterquam quòd inspirationis primum est instrumentum, aluique faecibus exturbandis opitulatur, cordis quoque regionem ab infimo ventre et intestinis tanquam paries interiectus dirimit.¹⁹

Greeks call them cotyledons, through which the menstrual blood trickles out at regular times, and also in pregnancy nutriment is conveyed to the fetus; at other times they are closed. They are most narrowed in those who have died, so that in no way can the power of sensation discern them. Some of the small channels mentioned reach to the end of the uterine cervix, and through them a little menstrual blood bursts out in virgins.

[P22] When the uterus is cut in two lengthwise, it displays two cavities, right and left, without separating partition, empty and quite smooth, and so narrow that they can hardly admit a biggish bean. They share a route into the uterine mouth, which is extremely narrow, and resembles the glans at the end of the male genitalia. The cervix comes next, made partly of muscle, partly of membranes and nerves, and is long enough to end externally in the female private parts. It underlies the neck of the bladder, and is completely attached to it through shared muscle. Thus in women there are three openings: the uppermost the very narrow opening of the bladder, the middle the vulva, the lowest the anus. Most people maintain that the neck of the uterus is interrupted about the middle of its length in virgins by a thin membrane scattered with little veins, which is generally burst at first sexual intercourse, with profuse bleeding; hence it is named hymen or hymenaion by the Greeks. But I believe instead that the walls of the cervix in those who have not had intercourse just adhere together as though glued, and the first coitus largely splits them apart. Outside in the private parts is the cartilaginous orifice of the vagina, thrown into wrinkles of skin, which prevent colder air getting inside. In the middle of its cleft is a muscular small piece of flesh called nympha and clitoris by the Greeks, comparable to the foreskin of the male's penis. We will give a full account of everything that normally develops in the uterus around the fetus when we examine fetal development. So I think the whole description of the lower belly has now been satisfactorily completed.

Chapter 8. The vital parts.

THE MIDDLE belly in the body is devoted to the heart and vitality, since it is regarded as its home and base. For the lungs were created as a kind of bedspreads for the heart, to moderate its heat with the cooler breath they have taken in. The boundaries of this belly are the collarbones above, the diaphragm below, and the back, the ribs and the chest all around. The diaphragm, which we call the girdle and the septum transversum, in addition to being the primary instrument of inhalation, and assisting in the expulsion of feces, separates the

Id verè simplex est musculus, ísque rotundus, cuius summum caput in costarum extremis statuitur, vbi multae carnis est particeps: desinit autem in medium quod membranosum est et tendoni finitimum. Annexum id malo punico, circumductúmque per breuium costarum (νόθαι Graecis appellantur) extrema, retrorsum simúlque deorsum obliquè contorquetur ad duodecimam dorsi vertebram. Tres insignes canales id traiiciunt, gula, arteria maior, et vena caua. Alitur viuítque venis et arteriis è proximo susceptis, partéque media exiles nervos admittit, de quibus posthac pleniùs verba fient. Id vtrinque valens tegit membrana, subter quidem peritoneos, super ea quae costas succingit. Haec enim est quae omnem thoracis capacitatem intus oblinat obducitque, inter quam et costas congestus humor pleuritidem committit. Ea igitur primum è dorsi spina per costas vtrinque subtensa, diaphragma quoque vniuersum integit, sublatáque in os pectoris medium, laterum concursu duplex facta, mox in dorsi spinam (pulmones medios diducens) rectà dilabitur. Itaque omnem pectoris capacitatem dirimit duplex haec membrana, quam interseptum possis appellare, aut si Festi verbum placet, dissepimentum:²⁰ cuius beneficio si alter sinus incommodum acceperit, alter saluus et incolumis seruari possit. Haec ipsa venas maiores, arterias et nervos, rursum indidem gulam, pulmones, denique cor ipsum firmo nexu fulcit, ac è pectoris osse sustinet, ne pondere suo propendens in sese et in dorsi spinam concidant. Si accurata fiet haerentium membranarum distractio, cernetur inter eas abditum περικάρδιον. Est autem id membrana cordi circumiecta, quam illius inuolucrum et capsam appellamus. Substantia nervosum, constans et durum, vnum ex omnibus è cordis capite natum: caeteris enim in thorace membranis omnibus vna succingens tanquam parens ortum praebet. Cordis figuram id aemulatur, eo quidem aliquanto maius, non enim proximè adhaerescit, sed inani interuallo disiunctum est, quantum cordis pulsatio desiderat. Ne quid tamen frustra conditum videretur, natura in hoc spatij [*sic*] tenuem humorem aquae persimilem coniecit, quo semper cor maderet, ne fortè ardore assiduo torreretur. Pericardij è medio cor erectum figitur viuientibus, [P23] nulla illius parte circùm oppressum. Caput quod et basin rectè nuncupes (est enim figura pyramidis) sub osse pectoris ad quintam costam consedit, turbinato autem mucrone infra laeuam papillam in priora thoracis eminet, vbi insignis et conspicua pulsatio

region of the heart from the lowest belly and the intestines like an inserted partition. It is certainly simple muscle, a circular muscle, with its upper extremity set on the ends of the ribs, where it shares in a great deal of flesh. It ends in a center that is membranous and tendonlike. It is attached to the xiphoid cartilage, and surrounded through the ends of the short ribs (the Greeks call them bastard ribs), and inclines at a slope backwards and downwards toward the twelfth thoracic vertebra. Three notable channels traverse it: the esophagus, the aorta, and the vena cava. It is nourished and kept alive by the veins and arteries picked up from nearby, and in its central part it receives slender nerves, of which a fuller account will be given later. A strong membrane covers it on each side: below, the peritoneum; above, the membrane that undergirds the ribs, the same one that lines and envelops the inside of the chest cavity, and humor accumulated between it and the ribs brings on pleurisy. It starts by being stretched from the dorsal spine throughout the ribs on each side, and also covers the whole of the diaphragm. Taken up into the middle of the sternum, it becomes double through the meeting of the two sides [of the chest cavity], and next falls straight back onto the dorsal spine, separating the lungs in their middle. Thus this double membrane splits the whole chest cavity, and you might call it a partition, or, if Festus's word is preferred, a dissepiment. Its bounty enables one cavity to be kept safe and intact if the other has come to harm. It supports with a firm grasp from the sternum the greater veins, arteries, and nerves, and from the same base the esophagus, lungs, and finally the heart, to prevent them falling under their own weight on top of each other and of the dorsal spine. If the membranes adhering to it are carefully drawn apart, the pericardium will be seen hidden among them. This is the membrane enveloping the heart, which we call its sheath and case. In substance it is nervous, uniform, and hard, the only membrane originating from the top of the heart, since all the other thoracic membranes stem from, so to speak, the one encircling parent [i.e., the pleura]. It adopts the heart's shape, but is a little larger, since it does not stick closely to the heart, but is separated by an empty space, as large as the heart's pulsation requires. To show that nothing is created in vain, nature has placed in this interval a thin humor very like water, to moisten the heart continually and prevent its being scorched by the incessant heat. During life the heart is secured upright in the middle of the pericardium, under no surrounding pressure from any part of it. [P23] What is correctly termed the head and base of the heart (its shape is pyramidal) is situated under the sternum at the fifth rib, and with its conical tip it protrudes against the front of the chest below the left nipple, where a notable and obvious pulsation can be detected by

tangentibus nobis deprehenditur. Summis pulmonum fibris ita circumplicatur, vt his vniuersum quasi sepultum conditumque mergatur. Quaecunque timida atque ignaua sunt animalia, grandius iis cor datum est, caeteris autem pusillum aut mediocre. Cordis autem caro densa est roboris nacta plurimum, vixque patibilis: ita enim exigebat vis illa feruens innati caloris, et perpetua necessarij motus agitatio. Non enim motionis huius potestas in nobis sita est, neque huic imperandi ius habemus, quae naturae legibus, non (vt quae musculorum est) nostro arbitrio perficitur. Ex quo perspicuum euadit, cor neque musculus esse, neque ex musculis compluribus coagmentatum. Villis id contexitur quoquoersum exporrectis, quò motus omne genus impleat atque praestet, in quibus tamen roboris multò plus inest quàm in musculis: vt quos ex semine non ex neruorum aut vinculorum tenuitatibus ei datos esse, posthac euident erit. Cordis talem substantiam conueniebat crasso necdum attenuato sanguine nutrir, quem iccirco infert ramus, ex vena caua nondum dextrum cordis sinum subeunte, in exteriorem ambitum productus. Quibuscunque porrò animantibus pulmo datus est, iis in corde geminus est sinus, dexter ac sinister: in piscibus vt mutis ita pulmone destitutis, vnicus apparet, et in conspectum se dat. Dexter modicè concauus est, pariete cinctus tenuiore: sinister altior in extremum cordis verticem pertingit, pariete crassiore obuallatus. In hoc siquidem plurimus isque attenuatus spiritus contineri debebat, cuius cor principium est atque origo: in illo autem sanguis densior concretiorque spiritu, atque is paucus qui alendis pulmonibus satis esset. Vtroque cauo carnosae neruorum stamina intercurrunt, atque vtriusque bini sunt canales. In dextrum enim vena caua è iecinere per septum sublata, de sinistro suo pariete amplum sed breuem ramum inserit. Ex eodem cordis sinu alia rursum vena surgit irrepitque in pulmones, quà iam attenuatus sanguis idoneum pulmonibus alimentum prouehitur. Duplici autem tunica hanc natura muniuit, ne simplex prae sanguinis tenuitate hanc atque illac perflueret: hinc arteriosae venae nomen illi impositum. Nihil huic quidem commercij intercedit cum vena caua, quandoquidem duplex simplici non continuatur neque cohaerescit: totam igitur hanc ex corde nasci oportebat. Ex duplici enim tunica constant quicunque exeunt canales ex corde, simplici verò qui illuc inseruntur. In laeuum cordis sinum ex pulmonibus canalis incurrit, quo ductus de aëre frigidior spiritus, è pulmonibus in cor transilit. Quatenus hic aërem spiritumue transuehit, arteria dictus est: veruntamen quòd nondum crassior hic aër in vitalem spiritum conuersus sit, vna duntaxat tunica ei satis erat, iccirco arteria venosa nuncupatur. Ex hoc ipso sinu

our fingers. The uppermost fibers of the lungs wind so close around it that it seems wholly hidden and sunk from view among them. Timid and cowardly animals have rather a large heart, but the rest have a small or average one. The heart's flesh is firm and possesses a great deal of strength, and is almost insensitive, as was necessitated by the well-known burning power of the innate heat, and the unceasing activity of its inevitable movement. For there is in us no power over this motion, nor any right to control it; it functions under the laws of nature, not under our control like muscular activity. From this it clearly emerges that the heart is not a muscle, nor a combination of several muscles. It is woven from filaments extending in every direction, so as to execute and provide every sort of motion, but much more strength resides in these filaments than in muscles. As will later become clear, the filaments are contributed to the heart out of the seed, not out of the minute parts of nerves or ligaments. It was appropriate for heart substance like this to be nourished from thick blood, not yet thinned out, brought in for the purpose by a branch from the vena cava before it reaches the right chamber of the heart, and extending to its outer circumference.⁹³ Further, in animals possessed of a lung, the heart has a twin cavity, right and left; in fish, which are silent and lack a lung, a single cavity is visible and makes itself obvious. The right cavity is moderately hollow, surrounded by a thinner wall. The left one is taller and reaches right to the tip of the heart, fortified by a thicker wall: it had to hold a great deal of thinned spirit, of which the heart is the origin. The right one had to hold blood, denser and more compact than spirit, and only enough to nourish the lungs. Across each cavity fleshy strings of nerve run, and each has two channels. Into the right one the vena cava runs up from the liver through the diaphragm, and from its left wall introduces a short wide branch. From the same side ["sinus"] of the heart there arises another vein that makes its way into the lungs, and carries thinned blood suited as the nutrition of the lungs. Nature has provided a double coat for it, in case a single one might leak one way and the other because the blood is so thin;⁹⁴ hence it is given the name "arterial vein." It has nothing in common with the vena cava, since a double structure is not continuous with nor attached to a single one; so the whole of it had to be generated from the heart. All the channels that run out from the heart are composed of a double coat, and those that run into it of a single one. A channel enters the left cavity of the heart from the lungs, by which the chillier spirit derived from air springs across into the heart from the lungs. By virtue of transporting air or spirit, it is called an artery; but since this thicker air is not yet converted into vital spirit, just one tunic is enough for it, and it is called the venous artery. From this same cavity the

emergit arteria maior ἀορτή, in corpus omne diffusa: quae cū ad tenuissimi spiritus custodiam tunica duplici condita sit, nihil cum arteria venosa communicat. In maioris autem arteriae exortu quaedam animantes, vt cerui, vt damae, os tanquam radicem aut basin gerunt: quod scribit Galenus reliquis quoque omnibus inueniri, minoribus quidem velut membranam, mediocribus velut cartilaginem, maioribus vt elephantis, bobus, et hominibus os cartilaginosum. Cor auritum esse multi praedicant, huicque vtrinque è capite auriculas eminere. Sic enim placuit illis nervosas membranas appellare ob sinuum introitus positas, quarum imprimis est arteriam venosam venamque maiorem fulcire, quae tenues vix alioqui pulsationis impetum sustinerent. Dein etiam ita conditae sunt, vt sanguinem et spiritum cor in se promptius attrahet [corrected to “attraheret” in Errata at end of the volume], sibi que ventilationem moliretur [*sic*], ipsis nimirum follium instar agitatis atque inflatis vicissim et concidentibus. Caeterum mirificum hīc naturae arcanum contemplerur in appellatis valvis positum: quae quidem membranae sunt in canalium atque vasorum extremis, quarum dilatatio extremitates obturat, contractio recludit. Iis vasis et canalibus qui in cor subeunt et materias inuehunt, membranae foris intrò spectant, ne quod intromissum fuerat, refluere possit: vena caua membranas tres pro valvis accepit, arteria venosa duas, quae ambitum interiorem circumdant. Duobus aliis è corde promptis ductibus, diuersa est [P24] valuarum constitutio, vt quae foras spectent et apertae sint, ne quod aliquando è corde effusum fuerat, in id ipsum remeet: eiusmodi sunt in maiore arteria et in vena arteriosa, in vtraque quidem ternae. Sic igitur rerum natura tulit, vt dum cor contractis in se rectis staminibus atque villis dilatatur (qui motus Graecis διαστολή vocatur) materias prolectet: in sinum quidem dextrum, sanguinem ex vena caua, in sinistrum, aërem ex pulmonibus. Horum quidem tum valvae depressae conniuent, vt haustae materiae cedant: aliorum autem distentae patent, ne tum pariter quicquam de se cor extrudat. Mox verò contractis transuersis villis, coarctatur cor (συστολή dici solet) acceptasque materias de se refundit, spiritum quippe ex cauo sinistro in arteriam maiorem: è dextro sanguinem attenuatum per venam arteriosam in pulmones, hocque tempore istorum valvae depressae sunt, aliis stantibus atque sublatis. Atque haec de corde satis. Pulmo spirandi officina nullo vel minimo puncto temporis intermisso mouetur, spiritum identidem recipiendo ducit

greater artery, the aorta, emerges, and is dispersed into the whole body; since it possesses a double coat in order to retain the most rarefied spirits, it has no connection with the venous artery. In the source of the aorta some living creatures such as stags and fallow deer possess a bone as its root or foundation. Galen writes that it is present in the rest of the animals too, but in the smaller ones it resembles a membrane, in the ordinary-sized ones a cartilage, and in the larger ones such as elephants, oxen, and human beings, a cartilaginous bone. Many people teach that the heart possesses ears, and that these auricles protrude on each side from its top; they chose to name thus the nervous membranes lying across the entrances to the cavities, which have the main task of supporting the venous artery and the greater vein, which would hardly otherwise be thick enough to withstand the force of the pulsation. Also, they are set up in such a way that the heart was drawing blood and spirit into itself more quickly, and was working at its ventilation, while the auricles evidently are driven like bellows and alternately inflate and collapse. But let us consider the extraordinary secret of nature evident here in what are called the valves. They are membranes situated in the ends of the channels and vessels, and their dilation blocks the ends, while their contraction opens them. In the vessels and channels that run into the heart and convey materials in, the membranes face inward from outside, so that what had been put in cannot run back again. The vena cava possesses three membranes as valves, and the venous artery two, which surround its circumference inside. [P24] The two other channels that leave the heart have a different arrangement of their valves: they face and open outwards, so that what had been at any time ejected from the heart cannot make its way back, and are of this type in the aorta and in the arterial vein: three valves in each case. Nature therefore made the arrangement such that when the heart is dilated through the contraction of the straight threads and filaments inside (the movement the Greeks call diastole), it attracts materials: blood from the vena cava into the right cavity, and air from the lungs into the left cavity. At this time one set of valves is pressed down and in apposition, so that they yield to the material that has been taken in; the others are inflated and wide open, so that the heart does not expel anything out of itself at the same time.⁹⁵ Presently, when the transverse filaments contract, the heart is narrowed (this is usually called systole), and ejects from itself the materials it has received: spirit from the left cavity into the aorta, and thinned blood from the right cavity through the arterial vein into the lungs. At this time their valves⁹⁶ are pressed down, but the others are erect and out of the way. This is enough about the heart.

The lung, the workshop for breathing, is in movement all the time, or almost all the time, and by a continuous back and forth action inhales and

reddítque. Haustum hunc conficit praeparátque cordi, vt iocineri alimenta ventriculus: cuius demum accessu innatus calor ventilatus refrigeretur, et vitalis spiritus alatur foueáturque tanquam pabulo. Quocirca pulmonum caro mollis facta est, leuis, rara, spongiae assimilis, ad hauriendum concipiendúmque spiritumque aptissima. Figura quae vngulam bubulam aemuletur. Eam prae se fert molis amplitudinem, vt in viuentibus pectoris vniuersum cauum impleat: at ei qui ex hac vita migravit exilis collapsúsque flaccescit, nec si fistula infletur, tumorem tantum referre possit, quantus in viuente extabat. Considit in dorsi vertebriis, quibus et pectoris ossi inter sepientis [*sic*] membranae vinculo committitur. Illum eadem geminum facit, vna quidem parte in dextris costis, altera recumbente in sinistris: atque vtriusque binae sunt insignes fibrae, praeter quas minor quaedam aliarum velut soboles, in dextra parte tanquam stratum subiicitur venae cauae contendenti ad clauas et iugula. Tunica pulmo obducitur praetenui, per quam pus aut sanies in pectoris capacitate per suppurationem aliúmue affectum congesta permeare possit, et quasi sucta peruadere, hínque per exiguas arteriarum fistulas ad maiores, tandem verò ad asperam arteriam atque foras tussi propelli. Triplici vasorum genere retis modo implicatorum pulmonis caro sustinetur et cohaeret, vena arteriosa, quae è sinu cordis dextro nata in omnes pulmonis particulas sparsa diffinditur: arteria venosa, quae ex omnibus eius particulis tenues riuos tanquam radices excipiens, trunco vnico in sinistrum cordis sinum intruditur: aspera denique arteria, quae à faucibus ortum ducens in duas regiones primùm biuio distracta, mox deinde in minores tandémque in minimas dissecta, in pulmonem vniuersum decurrit. Itaque trium vasorum extrema in eiusmodi tenuitates sectione discernuntur, vt in pulmonem prorsus absumptae oblitescant, nec vsquam continuatae cernantur. Quocirca aër in pulmones haustus inspiratione, primùm quidem asperas arterias duntaxat implet, neque continuò in laeues illabitur, quas venosas appellauimus: verùm illinc in substantiam pulmonum diffusus conficitur, atque iam satis extenuatione praeparatum, cor distentum laeuum arteriarum ductibus prolectat et attrahit. Ergo vt ab ore via in ventriculum directa ferebatur, sic et altera ex eodem ducit in pulmones, vt iccirco rectè biuias fauces possis appellare. Proximè enim ceruicis vertebrae intus gula reconditur, esculentorum potulentorúmque via: extrà parte priore et obuia in longum huic adhaerescit guttur, τραχέϊαν ἀρτηρίαν vocant, qua solus spiritus deducitur. Fistulam planè refert breuem edendae voci aptissimam, cuius pars membranis, pars cartilagine continetur. Hanc enim complent in dimidiatos orbes ad C. literae speciem actae cartilagines, interiectis membranis copulatae.

returns spirit. It processes this draft for the heart, as the stomach processes food for the liver, and it is the draft's arrival that ventilates and cools the innate heat, and feeds and cherishes the vital spirit like nourishment. For this purpose the flesh of the lungs is made soft, light, loose, like a sponge, and eminently suitable for taking up and holding spirit. A shape to resemble an ox hoof. It provides enough bulk to fill the whole of the chest during life; but after death it goes thin and flattened and slack, and even inflation through a tube cannot restore its fullness to what it was in life. It lies upon the dorsal vertebrae, and is attached to them and to the sternum by the bond of the membranous partition [mediastinum]. The partition makes the bond a twin one, one side resting on the right ribs and the other on the left ones; each has two notable lobes, and there is in addition a lesser offshoot of the others, like a pillow on the right-hand side underlying the vena cava as it makes its way to the clavicles and neck. The lung is covered by a very thin membrane, through which pus or gore assembled by suppuration or other disorder can travel in the chest cavity, and penetrate as if sucked, from here through the small arterial tubes to the larger ones, and in the end to the trachea, and be coughed out. Lung flesh is supported and held together by three kinds of vessel woven together like a net: the arterial vein, which starts from the cavity of the right heart and splits up scattered into all parts of the lung; the venous artery, which picks up fine streams like roots from all these parts, and enters the left cavity of the heart by a single trunk; and finally, the trachea, which takes its origin from the throat, splits first into two to reach the two regions, and soon thereafter breaks up into smaller and finally tiny branches to reach the whole of the lung. So the ends of three vessels are dispersed into fine details of this sort when the lung is cut, so that they vanish completely into the lung, and cannot be traced anywhere in continuity. Consequently the air that is inhaled into the lungs at first just fills the bronchi,⁹⁷ and does not pass into the veins⁹⁸ straightaway, but diffuses from these bronchi into the substance of the lungs and is perfected; then, when it has been thinned enough, the dilated heart entices it in by the arterial channels. So, as a path led straight from the mouth to the stomach, in the same way another leads from it into the lungs, and hence you may speak correctly of two throat paths: the esophagus, the path for food and drink, is hidden inside right beside the cervical vertebrae, while sticking to its length outside in front and obvious is the windpipe, called the trachea, by which spirit only is carried down. It clearly resembles a short pipe well adapted for producing the voice, and is partly enclosed by membranes and partly by cartilage. The cartilages that make it up are formed into half rings like the letter C, linked by intervening membranes.

Quinetiam his intus alia densa subtenditur, cuius villi in rectum abeunt: alia extrinsecus velut tegumentum omnem cingens arteriam: his etiam suffultae venulae tenues alimentum fundunt atque subministrant. Eam profectò fieri decebat arteria compositionem, quae tracto redditòque spiritui assiduè pateret, et vocem suauem ac splendidam suggereret laryngi: nam mollior absonam atque absurdam, siccior verò intentam, et clangori persimilem emisisset. Ergo quantum huius arteriae supra clauas extat, perfectos orbes haudquaquam accepit: nam quicquid parte posteriore gulam attingit, sola membrana cingitur, vt crassioribus esculentis in ventricu-[P25] lum illapsuris locum daret cederétque. At verò quantum arteriae sub clauibus in pulmones confertur, gulae non cohaeret: quocirca cartilaginosos orbes perfectos obtinuit. Summum arteriae caput λάρυγξ appellatur, proprium aedendae vocis instrumentum. Ex tribus hic magnis cartilaginibus absoluitur, quarum maxima veterum scuto similis, foras prominet, nobis tangentibus obuia: illic quidem firma atque dura, at parte posteriore membranosa. Interior huius capacitas (longa enim est et ampla) reliquas minores duas includit cartilagines, parti posteriori obiectas, sic inter se vinculis neruosis obstrictas, vt tribus hisce compactus larynx, cartilaginosus totus esse videatur, orbisque figuram implere. Inferum extremum asperae coniunctum arteriae, quàm [*sic*; also in 1542] summum patet amplius: hoc enim praecipuè modulatur vocem. Quoniam igitur larynx simplex cartilago non est, dilatari certè potest vel coangustari, claudi vel recludi nostro nutu et arbitrio. Clauditur quidem in spiritus interclusione atque comprehensione: coarctatur angustiorque fit, cùm vox elidi debet: at prorsum laxatus patefit, dum inspiratio respiratióue simplex inducitur. Motibus tam variis atque distantibus natura multiformes musculos adhibuit, quos suprà viginti commemorauimus, proprios quidem duodecim, communes octo. Sex inter hos ex imis nati partibus, laryngis cartilagines deorsum vellunt atque deducunt, habéntque idcirco neruorum tenuitates ex infernis partibus allatas. At cum omnium interiorum neruorum è cerebro communis sit origo, istos quoque è sexta coniugatione ad pectus, cum iis qui ad os ventriculi contendunt, aliquantum deriuari compertum est, hínque ad sex memoratos laryngis musculos reflecti: inde recurrentes nerui sunt appellati. In eo autem loco vnde regrediuntur, sinister maximam arteriam, qua parte ex corde in dorsum flectitur ac detorquetur, circumplicat: dexter verò eum arteriae ramum cicumuectus [*sic*; corrected to “circunuectus” in Errata at end of the volume; “circumuentus” in 1542 and 1554] amplectitur, qui in alam dextram procedit: his tanquam radicibus innixi sursum replicati nerui atque conuersi motum ei persimilem obeunt, qui in architecturae machinis trochlearum ope completur.

A further thick membrane underlies these, with filaments that run straight from it, and another outside holds the whole trachea together like a sheath. These are supported by thin venules that furnish them with nutriment. This was surely the proper composition for the trachea to acquire, since it stayed open continually as spirit was drawn in and returned, and supplied an appealing and distinguished voice to the larynx: a softer composition would have given out a discordant and ridiculous voice, a drier one a strained voice very like a bark. Consequently the part of the trachea above the clavicles does not possess complete rings; the side touching the esophagus at the back is held together by membrane only, so as to provide room for the more solid items of food on their way to the stomach. [P25] But the part of the trachea below the clavicles and entering the lungs is not attached to the esophagus, and so it has obtained complete cartilaginous rings.⁹⁹ The upper extremity of the trachea is called the larynx, the particular instrument for generating the voice. It is completed from three large cartilages. The biggest of these resembles a traditional shield, and protrudes externally, being obvious to our touch, and compact and hard on that side, but membranous at the back. Being long and wide, its internal cavity encloses two other smaller cartilages, facing the back, and so tightly bound together by nervous ligaments that the larynx with its three components seems entirely cartilaginous, and ring-shaped. Its lower end is linked to the trachea, and opens more widely than the top; this is the part that particularly regulates the voice. Since, then, the larynx is not simple cartilage, it can certainly widen or narrow, and be closed or opened by our will. It is closed during holding of the breath. It is narrowed when the voice needs to be forced out. But it opens completely slackly while inhalation or simple exhalation are being conducted. Nature has employed muscles of many shapes for such varied and extensive movements; we described twenty above, twelve specific ones and eight shared ones. Six of these with origins in the lowest parts pull the laryngeal cartilages down, and therefore have fine nerve branches reaching them from below. But since all the nerves of the interior have a common origin from the brain, these too are found to stem substantially from the sixth pair near the chest, along with those that are making for the mouth of the stomach, and bend back from there to the six laryngeal muscles mentioned. Hence they are called the recurrent nerves. Where they retrace their steps, the left one winds round the aorta where it arches from the heart to the back. But the right one passes closely round the branch of the aorta that runs to the right armpit [the right subclavian artery]. Supported by these roots, the nerves bend back upwards and mimic the movement that is carried out in building machinery by the use of pulleys.¹⁰⁰ To

Laryngis introitum summumque ostium, ne quid mandendo deuorandoue in id incidat et illabatur (alioqui enim semper pateret) contegit occluditque membrana cartilaginosa, oblonga, fistularum linguae assimilis, vnde ei nomen ἐπιγλωττις: magnitudine paulò amplior laryngis ostio, quò id firmiùs obseraret. Haec dum inspiramus atque respiramus sursum erigitur, incubat autem laryngi dum cibus demittitur, ne quid huius abundanter et vniuersè irruat in arteriam. Pulsillum siquidem praesertimque potus influit, neque tamen incommodat, sed dum membranam irrigat madefacitque pulmones, prodesse creditur, hoc argumento quòd vtrinque laryngi additae sunt glandulae, quae humore suo subditas illas partes imbuerent. Non igitur inter vorandum arcè obseratur, quemadmodum dum spiritus intercluditur: tum enim eatenus depressa epiglottide obturatur larynx, vt ne minimum quidem conclusi spiritus erumpere possit et excedere. Id autem quia praestat epiglottis, simul verò quia eadem ducti redditique spiritus modum accessu recessuque suo temperat, hincque omnes vocum varietates modulatur, primùm illa nimirum statuitur vocis instrumentum. Caeterum lingua ori indita explanatae distinctaéque vocis fictrix atque moderatrix est, et mentis voluntatisque nuntia. Eadem saporès diiudicat, eximio et voluptario gustandi sensu praedita. Substantia illi rara atque laxa, vt humore saporum vectore faciliè imbuatur: quocirca tunica cingitur praetenui, quae toti quoque ori communis est. Nouem struitur musculis vndique constitutis, quos media linea ad dextram laeuamque dirimit, vt hoc vti et reliqua sensuum instrumenta, geminum foret. Cùmque summè volubilis esset et incitata, ne fortè indomita plus aequo in loquacitatem solueretur, subdito vinculo tanquam habenis cohibetur. Venis praeterea duabus maiusculis totidémque arteriis perfunditur, duobus item neruorum coniugiis: altero duriore, quod in musculos distributum motus efficit, altero molli internoscendis saporibus destinato. Pertinet autem irrepitque hoc genus magna ex parte in externam ambientemque tunicam. Lingua ad radicem quà latior est et faucibus cohaeret, osse valido quasi basi nititur sustentaturque, quod ὀστέον Graecis dicitur, literae Y. speciem habens. Huic vtrinque assistunt glandulae, quas peculiari nomine nostri tonsillas, Graeci παρίσθημια di-[P26] xere: perpetua quibus vis est eructandi saliuam, vt madefiant lingua, larynx, arteria, ipsique pulmones. Inter eas ab extremo palato dependet caruncula rotunda, voci ad suauitatem atque modulationem velut plectrum conducibilis, Graecis γαργαρέων, quibusdam ficto nomine gurgulio, at propriè columella dicta: quae dum humoris influxione

prevent anything slipping into the entrance at the top of the larynx during chewing and swallowing (it would be always open otherwise), it is covered and blocked by an oblong cartilaginous membrane, like the tongue or reed of panpipes, whence its name epiglottis. It is a little larger than the laryngeal opening, so as to close it more tightly. While we inhale and exhale, it stands upright, but while food is passing down, it rests on the larynx, so that none forces its way copiously and completely into the trachea. If a little porridge, or especially some drink, runs in, it causes no trouble, but is regarded as doing good by damping the membrane and moistening the lungs, on the argument that glands are attached to the larynx on each side, to wet with their humor those parts that lie below. So it is not tightly closed during swallowing, in the way that it is while the breath is held; at that time the epiglottis is pressed down and the larynx is so tightly blocked that not even the least escape of the pent-up spirit can occur. Since the epiglottis does this, and since as well it regulates the way spirit passes in and out by its approach and withdrawal, thus controlling all the types of voices, it is naturally reckoned the principal instrument of the voice. But the tongue, lying within the mouth, is the shaper and controller of clear explanatory speech, and the messenger of the mind and will. It distinguishes flavors, being endowed with a remarkable and delightful sense of taste. Its substance is loose and slack, so as to be readily imbued with the humor that conveys flavors; accordingly it is covered with a very thin coat, in common with the whole of the mouth. It is built from nine muscles, arranged from all sides and divided into left and right by a central line, to make it paired like the other sense organs. When it is particularly active and talkative, it is reined in by a tie below in case it should be dispersed into excessive chattering without restraint. Further, it is supplied by two fairly large veins and the same number of arteries, and also by two pairs of nerves: one is harder, and dispersed into the muscles brings movement about, while the other is soft for the task of distinguishing flavors. The latter kind belongs and is distributed mostly to the coat surrounding the outside of the tongue. At its root, where it is broader and attached to the throat, the tongue relies for support on a strong bone that the Greeks call the hyoid, since it resembles the letter Y. Beside it there are glands on each side, to which we give the special name of tonsils, and in Greek *paristhmia*. [P26] They have the permanent ability to emit saliva, so as to moisten the tongue, larynx, trachea, and the lungs too. Between them there hangs down from the end of the palate a rounded piece of flesh that serves as a plectrum to sweeten and regulate the voice; the Greeks call it *gargareon*, and some use the bogus name *gurgulio* [gullet or windpipe], but the right name is *columella*. When it is swollen and

tumet et inflammatur, vuae nomen accipit. Hinc palatum ad primores dentes extenditur, cui perinde atque linguae per neruum vis data est sapes internoscendi: ad vocem id iuxta ac reliquae oris partes necessarium, multis scabrum asperitatibus (Plinius crenas appellat) quibus cibum ad concoctionem praeparet. Haec sunt vniuersa quae oris mediique ventris capacitate continentur, de quibus hoc loco dicere statueram: nam dentium vt ossium explicationem proprio loco complexi sumus. Quocirca ad capitis interiora tempestiuum est sermonem transferre.

De capite. Cap. IX

Cerebrum humanae mentis arx et domicilium, cogitationum rationisque sedes, motus omnisque sensus, fons et origo: corporis summam partem tenet, sursum spectans, caelo proximum. Vt enim huius vniuersitatis parens mensque illa rectrix in caelo excelsissimo loco consedit, ita decebat cerebrum nostrae mentis arcem summo corpore collocari. Quoniam verò id viscerum praestantissimum, futurum erat irruentibus extrinsecus iniuriis obnoxium, naturae prouidentia vndique circumseptum est osseo tegumento, quod supra caluam appellauimus. Hanc vtrinque obuelant membranae, quarum interior crassa meninx appellata, villis compluribus caluae suturis adhaerescit, qui inde foras elapsi fusiùs latiùsque circumiecti, alteram exteriorem membranam conficiunt (Graecis est περι-κράνιος) capitis musculosae cuti proximè subiectam. Crassior dura illa meninx cum esset, cerebro vt propugnaculum aduersus caluae occursum data est: altera autem subest tenuis atque mollis idoneum cerebri inuolucrum, ei quam proximè adiunctum, quod et locis compluribus altiùs demergitur, vt interiores cerebri capacitates oblinat. At verò geminatae atque duplicatae meninges altiùs impulsae, primùm cerebrum à cerebello, quod Graecis est παρεγκεφαλῖς, prorsus disterminant: rursùmque cerebrum ipsum parte priore situm, in dextram laeuamque per summa duntaxat dirimunt, vt partes cerebri tres sint omnes geminis membranis seiunctae, omnesque iisdem supra subtérque ambientibus comprehensae. Cerebrum sub his homini spectatur maximum, quòd sit plurimarum virtutum sedes. Pars prior vt dixi gemina geminis quoque ventriculis intrò reconditis excauata, amplis iis quidem, sed magis viuientibus quam morte consumptis, quibus nimirum coangustantur omnia. Ex primis hi cerebri partibus initium ducentes, ad medias ferè regiones accedunt, inde paulùm reflexi in imam sedem detorquentur, quà basis est cerebri, et os quod à cuneo nomen habet.

inflamed by an access of humor, it gets the name uva [now uvula]. From here the palate runs out to the front teeth, and it too like the tongue possesses the power of distinguishing flavors, by means of a nerve. Like the rest of the mouth parts, it is essential for the voice, and is gnarled with many roughnesses (Pliny calls them wrinkles) by which it prepares the food for concoction. These are all the contents of the mouth and the middle belly, on which I had decided to speak at this point; we have covered the teeth and the bones in their proper place. So it is now time to move the discourse to the inside of the head.

Chapter 9. The head.

THE BRAIN is the citadel and dwelling of the human mind, the abode of thoughts and of the reason, the wellspring and origin of movement and of every sense; it occupies the highest point of the body, looking upwards, nearest to heaven. As the Begetter of all this, that notable controlling Mind, dwelt in the heaven of heavens, it was well to place the brain, the citadel of our mind, at the top of the body. But since the most distinguished of the organs was then to be exposed to the impact of external injuries, nature's foresight surrounded it completely with a bony protection, which we named previously the skullcap. Membranes cover it on each side: the inside one is called the thick meninx [dura mater] and sticks to the sutures of the skullcap by many filaments, which escape outwards from there and extend widespread to form another membrane outside, lying just under the head's muscular skin; the Greeks call it pericranios. Since this hard meninx was rather thick, it was provided for the brain as a protection against encroachment by the skullcap. There is another meninx underlying it, thin and soft, a suitable sheath for the brain, closely apposed to it, and plunging more deeply into it at numerous places, so as to line the internal cavities of the brain. But doubled layers of meninx, pressed more deeply in, entirely separate the cerebrum from the cerebellum, which the Greeks call parencephalis, and furthermore divide the cerebrum as it lies in front into right and left, just through its top, so that in all there are three parts of the brain separated by doubled membranes, and all enclosed by their embrace above and below. The human brain beneath is seen to be very large, being the dwelling place of very many virtues. The front, as I said, is twin, and hollowed out by twin ventricles hidden inside, which are large, but more so in life than after death, when of course everything shrinks. They originate from the foremost parts of the brain, they almost reach its center, then bend back a little and down to the bottom where the base of the brain is, and the sphenoid bone. The

Illuc ventriculorum riui confluunt, vbi locus est qui χοάνη id est infundibulum, aut πύλος, id est peluis appellatur. Huic subter crassam meningem subdita est glandula rotunda apertè concaua: glandulam mox excipit sustinetque tanquam basis os σφηνοειδές, à dextra laeuáque pertusum, cui mox subiiciuntur ossa adusque palatum spongiae modo rara, vnde σπογγοειδῆ vocantur. Quaecunque igitur in ventriculis tempore congeruntur superuacanea, sensim per riuorum ductus in peluim illabuntur, hinc in glandulam, cui tantisper inhaerescunt, dum per cunei foramina in os spongoides, et in palatum pedetentim instillent, forásque deturbentur. In illa autem ventriculorum caua, venarum arteriarúmque riuuli è summo cerebro pariter cum tenui meninge deuehuntur, quae inter se colligatae atque implicitae, contextus eos conformant, qui χοροειδεῖς appellantur, quíque capacitates intus succingunt et implent. Ex inferis quoque partibus, atque ex ipso contextu admirabili, per ea quae modo commemorauí foramina, arteriae tum in cerebri corpus, tum in eius ipsius ventriculos emergunt euadúntque, illis contextibus, vt dixi, innexae. Nam ex colli arteriis rami sursum euecti, cùm iam in cerebri basim permanarint, eásque capacitates attigerint, quae cuneo ossi subditae sunt, mox in tenuissimas arterias eásque plurimas dispersae multiformi varióque nexu citra vllius mem-[P27] branae copulationem, reti assimilem contextum conficiunt struúntque Graecis hic πλέγμα δικτυοειδές nuncupatur) [no opening bracket; 1554 placed one before “Graecis” and 1542 omitted both] qui os cunei non prorsus excessit, sed medius inter id et crassam meningem collocatur. Huius tenues arteriae omnes tandem in maiores duas confluunt, quae per cunei ossis et crassae meningis foramina elapsae, in cerebri corpus eíusque ventriculos commeant, eo quem dixi modo distributae. Iam verò prioris cerebri secretio ac diremptus quem in longum fieri memorauí, nequaquam adusque cerebellum perducitur, sed circa medium insistit, vt sit priorum duarum partium in mediam quandam eámque indiuiduam concursio. Sic propemodum qui prioribus illis partibus conduntur ventriculi, propriis ductibus in tertium quendam confluunt seipsis longè minorem, quíque nulla succingente membrana, sed sua duntaxat duritia consistat, tanquam fornix aut camera, vnde καμάριον dictus est et ψαλλοειδές. Cerebellum quod à cerebro duplicatae meninges seiungunt discludúntque, occipitis osse tegitur: cerebro quidem durius atque siccus, cuius pars extrema per spinae fistulam illapsa, in ossis sacri imum traíicitur, à qua vt ex arboris caudice rami, sic duriores nerui proferuntur. In eo ventriculus inest atque sinus prioribus minor, maior autem fornice; qui initio latiùs patet, at verò arcatur

streams from the ventricles unite there, at the point named choane (infundibulum¹⁰¹), or pyelos (pelvis). Below this a rounded and obviously hollow gland lies under the dura mater. Next, the gland is enclosed and supported by the sphenoid bone as its foundation, a bone perforated from right and left, and next below it lie bones as far as the palate that are of loose texture like a sponge, and so are called spongoeide. So whatever excesses accumulate in time within the ventricles slip gradually into this pelvis along the lines of the channels; thence into the gland, where they are held up for a little, until they drip through the openings of the sphenoid into the spongy bone, and slowly into the palate, and are discharged outwards. In that ventricular cavity the small streams of arteries and veins run downward from the top of the brain along with the thin meninx; they gather in knots and create the structures known as the choroid plexuses, which line and occupy the interiors. From the lower parts, too, and from the remarkable structure itself [the rete mirabile; see note 9 above], arteries traverse the holes that I have just mentioned, and make their way out into the brain proper and into its ventricles, attached as I said to these structures [the choroid plexuses]. For there are branches running up from the neck arteries, which after penetrating the foundation of the brain [i.e., the *bone* below the brain] and reaching the cavities below the sphenoid, next break up into extremely fine and numerous arteries diversely linked without any [P27] membrane to bond them, and compose a netlike structure (the Greeks call it the dictyoid plegma), which does not protrude much from the sphenoid, but lies between it and the dura mater. All its slender arteries run finally into two larger ones, which traverse the holes in the sphenoid and the dura mater, and enter the brain proper and its ventricles, distributed as I mentioned.

The lengthwise split in the front brain that I described does not involve the cerebellum at all, but stops around the middle, so that there is a coming together of the two front parts into a central undivided one. In a similar way the ventricles that exist in these front parts run together by connections of their own into a much smaller third ventricle, which has no enclosing membrane, but holds together by its own toughness like a vault or arch; hence it is called “camarion” and “psalloeides.”

The cerebellum is separated and cut off from the cerebrum by a double meningeal layer, and is covered by the occipital bone. It is harder and drier than the cerebrum, and its lowest part passes down through the spinal canal and into the bottom of the sacrum. From this part quite hard nerves are given off like branches from the trunk of a tree. There is a ventricle in it smaller than those at the front, but larger than the fornix. It is wider at the start, but narrows to a

extremo suo in mucronem compresso. A medio fornice canalis est proprio tegumento velatus, qui vnicus pertusis meningibus cerebrum committit cerebello. Ad eius introitum sita est glandula diuersae atque cerebrum substantiae, quae venis et arteriis in cerebrum fuis pro firmamento esse creditur, κωνόριον hanc appellant. Partes quae à dextra et à laeua canali assistunt, tument extántque adeò, vt plaerunque [*sic*] applicatae sese contingant: atque idcirco tanquam hominum clunes per illius longitudinem porrectae, γλουτία dictae sunt. His vtrinque copulata est tenuis et valida membrana, quae canalis superiora contegit. Membranae in longum incubat epiphysis vermi similis, hinc σκωληκοειδῇ appellant, reliquo quidem cerebro durior, ex multis constans particulis, quas tenues membranae vinciunt copulántque, vt produci contrahíque vermis ritu possit. Huius dorsum glutiis et copulanti membranae adhaeret, quod sua crassitudine glutiorum distantiam propemodum implet. Itaque vermis hic dum longiùs extenditur porrigitúrque per canalis longitudinem, fitque idcirco subtilior, inter glutia procumbit et obturat canalem: contractus autem in sese ampliórque factus, inter glutia delabi non potest, quinimo reuolutus secum vnà retrorsum vellit subleuátque membranam, quae glutia coniungit: quocirca tantum is canalem patefacit quantum retrorsum abscedit. Ea est omnium partium cerebri historia, quarum actiones sic in commune conferuntur. Priores ventriculi omnium maximi, crassiores cerebri sordes (nam tenues per suturas euadunt et foras se dant) suscipiunt et conferunt, quae quia cerebrum amplum, frigidum, humidúmque habetur, quamplurimae ex circuniectis partibus eò confluunt. Inde stillant aliàs per priora in os summum narium, quod vnà cum adhaerente membrana spongiae modo pertusum est: aliàs per peluim subditáque foramina dilabuntur in palatum, quanquam iis addita glans cursus celeritatem retardat. Alter porrò vsus praestantior est, ad quem natura ventriculos accommodauit, dum vitales ex corde spiritus in retis contextum effusos illícque praeeparatos, in priores ventriculos transmittit, vbi deinde vi innata cerebri in animales conuersi, in omnes sensus et in medium ventrem, tandémque in postremum diffiunt, vt ad sensus motúsque functiones suppetant satisque sint. Similis est cogitationum ratio, quas rerum sensibus comprehensarum spectra atque imagines in ventres illos euectae suscitauit. Has autem vias, quas ab extremis sensibus intrò natura produxit, deinceps exponemus. Cerebri partibus prioribus tubercula duo

point at its end. There is a channel from the middle of the fornix covered by a roof of its own, and it alone perforates the meninges and links the cerebrum to the cerebellum. There is a gland at its entrance that differs in substance from the cerebrum, and props up the veins and arteries entering the cerebrum; it is called the conarium [pineal]. The parts adjoining the canal on right and left bulge and protrude so as mostly to touch each other; because of the resemblance to human buttocks running lengthwise to the canal, they are called gloutia. A strong thin membrane is attached to them on each side, which covered the top of the canal. On the length of the membrane there lies an outgrowth like a worm, and consequently called scolecoeides, harder than the rest of the cerebrum, consisting of many small segments linked by thin membranes, so that it can expand and contract like a worm. Its back is attached to the buttocks and the linking membrane, and practically fills the gap between the buttocks with its width. And so as the worm expands further along the length of the canal, and consequently gets narrower, it sinks down between the buttocks and blocks the canal; but when contracted into itself and wider, it cannot slip between the buttocks. Instead, returning upon itself it pulls up the membrane that links the buttocks. Thus it opens up the canal according to how much it withdraws backward. This is the account of all the parts of the brain, and their actions are brought into general use in the following way: the anterior ventricles, the biggest of all, take up and transfer the thicker wastes of the brain (the thin wastes escape to the outside world through the sutures), which flow there in large amounts from the surrounding parts because the brain is reckoned spacious, cold, and damp. From there they drip at some times through the front into the top bone of the nose, which along with its attached membrane is perforated like a sponge. At other times they flow through the pelvis¹⁰² and the holes underlying it into the palate, although the gland annexed to them [i.e., the pituitary] slows the speed of passage. Further, there is another more notable use for which nature has fitted the ventricles, during her transmission of the vital spirits from the heart into the front ventricles [of the brain] after their emergence into the network structure [the rete mirabile] and their preparation there; next, after conversion into animal spirits by the innate ability of the brain, they disperse into all the senses and into the middle belly [i.e., the thorax], and ultimately into the lower one, so as to suffice for the functions of sensation and motion. The basis of thoughts is similar: they are prompted by the images of things grasped by the senses, images transferred out into these cavities.

We shall next explain these channels that nature has established leading inwards from the sense endings. In the front of the brain there are two prominent

extant et eminent mammarum papillis simillima, quae summo narium ossi spongiae aemulo obiecta insident. Sub his exiles proceraeque productiones mollioribus nervis comparatae sese expromunt, quas in neruorum numero veteres nunquam collocarunt: at his tamen odoratum atque vim eam quae odorations aestimet, concesserunt, vt vna inter caeteras sentiendi vires è calua non exiliret. Siquando priores cerebri ventriculi mucosa eluuie affluunt et abundant, tubercula stillant in nares subditas, vt intelligi possit in haec vias è ventriculis patere. Iam verò neruorum qui ex ventriculis in sensuum instrumenta contendunt, propaga-[P28] tiones hae sunt. Omnium prima in oculos traicitur atque infigitur, cuius nerui insignes sunt, et inter caeteros maximè concaui, dicti Graecis ὀπτικοὶ molles ij et ampli, per quos videndi spiritus inuehitur. Duo quidem sunt vt oculi diuersis enati locis, sed qui à media cursus via quasi decussati coitionem faciant, móxque diducti in suum quisque è regione oculum fertur. Altera propagatio est neruorum oculos mouentium, qui quanquam opticis substrati post eos inseri videntur, exortu tamen in priores cerebri partes magis vergunt et accedunt, vnde nonnullis primi solent existimari. Exiles quidem duri atque validi, in eos musculos dispersi, qui oculos obsepiunt atque mouent. Tertia coniugatio ad gustatum pertinet. Ea quidem à prima statim radice permultis constat nervis iisque tenuibus, et quasi in vnum compressis atque coarctatis, quorum complures in linguae externam tunicam fusi gustandi sensu eam instruunt et illustant, híque ab ima cerebri parte nascuntur secundum quam linguae situs est. Reliquorum verò pars in superiorem, pars in inferiorem maxillam abit, sed via multò diuersa. Vnicus ad inferiorem pergit, qui cum ramulis gustum linguae praebentibus, per decliua patente quidem osse atque crassa meninge primùm deturbatur: at mox ab illis se subducens durior firmiórque factus, vt qui motum praestiturus est, in temporis eum musculum qui molitor appellatur sese infert: inde rectà in inferiorem maxillam multis villorum tenuitatibus diuaricatur, aliis in dentium radices, aliis in gingiuas et inferum labrum effusis. Qui superiorem maxillam adeunt, statim ad oculorum sedes adducti, cum iis durioribus nervis commeant qui oculos mouent, pèrque illorum foramina excidunt: transmissi deinde sub oculos ad os malae quod plurimum eminet, id perforant, vt inde diffisi in gingiuas dentésque superiores, in cutem faciei praetensam, et in superum labrum dispergantur. Simul autem dum hi malae foramen euaderent, vnum de se praetenuem ramulum in id foramen coniecerunt, quod in osse nasi ad oculi angulum maiorem vergit:

protuberances that closely resemble nipples, and lie up against the bone at the top of the nose that resembles a sponge. Under them long thin extensions present themselves like rather soft nerves, which the ancients never counted as nerves; but they allowed them the sense of smell and the ability to assess smells, so that among the other sensory powers there was one that did not get outside the skullcap. If the front ventricles of the brain ever overflow with mucous discharge, the protuberances drip into the underlying nasal cavities, so that it can be seen that paths open into them from the ventricles.

Now the nerve branches that pass out from the ventricles into the instruments of the senses are the following. [P28] The first pair of all passes across into the eyes and enters them; its nerves are conspicuous, and very hollow compared to the rest.¹⁰³ The Greeks call them optic. They are soft and wide, and the spirit of seeing travels along them. There are two, originating like the eyes on opposite sides, but so as to meet and cross over in the middle of their course, and then they separate and each runs to its own eye. A second outsprouting is that of the nerves that move the eyes; although they lie below the optic nerves and seem to be attached behind them, from their origin they tend more towards the front parts of the brain, so that some people usually reckon them the first pair. They are thin, hard, and strong, and distributed into the muscles that enclose and move the eyes. The third pair is concerned with taste. Right from the root it consists of numerous slender nerves, squeezed close together, many of them running into the outer coat of the tongue and embellishing it with the sense of taste. They arise from the lowest part of the brain, in line with the position of the tongue. Part of the rest departs into the upper jaw and part into the lower, by a very different path. One¹⁰⁴ makes its way to the lower jaw, and along with twigs providing taste for the tongue, starts by pushing down the slopes at a gap in the bone and the dura mater. But presently, detaching itself from them, and growing harder and firmer, being a nerve on its way to produce movement, it is inserted into the temple muscle called molitor. From there it spreads out straight into the lower jaw with many fine filaments, some running off into the roots of the teeth, others into the gums and the lower lip.

The nerves that proceed to the upper jaw, keeping steadily towards the eye sockets, travel with those harder nerves that move the eyes and emerge through their foramina. Then, crossing below the eyes to the very prominent cheekbone, they pass through it, to split up from there and be distributed to the upper gums and teeth, the skin stretched over the face, and the upper lip. Just as these were emerging from the foramen in the cheekbone, they threw off a single very thin branch into the foramen in the nasal bone close to the inner angle of the

hic inde in narium capacitatem illapsus, in eam membranam spargitur, quae naribus cum palato et ore communis est. Quarta societas et conuenientia, post tertiam proximè originem sumit, cuius nerui quàm illius exiliores quidem, sed tamen duriores sunt. Quanquam verò vtrique primo exortu concursuionibus inter se cohaerescunt, vt confundi, et è calua eodem foramine excedere et prodire videantur, mox tamen vt aliquantum sic processerunt, quarta coniugatio hinc se subtrahens, in palatum et in tunicam ori subtensam decurrit. Quinta coniugatio binis neruis continetur finitimis, proximéque inter se coniunctis, vt plerisque [*sic*] singuli putentur, cùm tamen iis planè diuersa sit origo. Horum itaque qui vtrinque duo sunt, prior audiendi neruus appellatur, quòd auris corneolum introitum subeat, crassa meninge sic arcè inuolutus, vt a quibusdam existimetur ab ea proficisci et initium ducere. Posterior in id ossis lapidosi angustum anfractibúsque flexuosum foramen se deuoluit, quod caecum nuncupant: forásque ad aurem emergens et durior factus, in temporis musculum, in genas, atque in partes auri circumiectas explicatur, ei tertiae coniugationis propagini opem laturus, quam dixi in tempus et maxillam inferiorem excurrere. Sexta (quae interioribus corporis partibus tangendi sensum praebet) ponè hanc ex ima cerebri parte profertur, et per suturae cui λ. nomen posuit patens extremum, caluam exit, compluribúsque statim ramulis exoritur, quos securitatis gratia natura eadem sepiente membrana, quasi in vnum coniectos obstrinxit. Quocirca ij quanuis [*sic*] negligenter spectantibus vnici videantur, tot tamen verè sunt à prima statim origine, quot omnino particulae in quas dispartiri disseminarique debent, diligentius intuenti duodecim aut etiam plures apparent. Omnes dum per ceruicem feruntur propemodum coniuncti apparent, vtrinque cum arteriis sociati quae inibi sunt. Longiùs autem progressi bipartitò dirimuntur. Alteri intrò per costarum radices abeunt membranis vincti, hincque deorsum pergentes lumborum interioribus musculis incumbunt, sic eo cursu deducti dum ossis sacri extremum contingant. Hoc longo viae tractu omnia propè intestina et viscera quae sub diaphragmate posita sunt, lien, renes, vesica, testes et vniuersum peritoneum, tenuitates quasdam ab illis acceperunt, per quas tactum participant: hunc enim sensum proximè è neruis cerebri asciscere decebat. Caeterum in prolapsione et transitu, [P29] spinae medulla illis duriores neruos è vicinis sedibus dispergit, vt ex amborum permistione simul cum tactu roboris constantiam et firmitatem attexeret. Alteri huius coniugij nerui

eye. This slips from there into the nasal cavity and disperses into the membrane that is common to the nose, the palate, and the mouth.

A fourth couple originates very close behind the third, and its nerves are thinner but harder than those in the third. Although both these right at their origin follow paths that stick together so closely that they seem to be combined and to leave the skullcap by the same foramen, yet presently after going a certain distance like this, the fourth pair detaches itself and runs down into the palate and the membrane lining the mouth.

The fifth pair comprises twin nerves adjoining each other, and so closely linked that most people take them for one, although their origins are clearly different. Thus of these two on each side, the front one is named the nerve of hearing, because it is to enter the horny entrance of the ear [the internal auditory meatus], so tightly wrapped in dura mater that some think that is its origin. The back one makes its way into the narrow and tortuous foramen of the stony bone [petrous temporal], known as the blind foramen [facial canal]. Getting out to the ear and growing harder, it spreads out into the temporal muscle, the cheeks, and the parts around the ear, to assist the branch of the third pair that I said ran out to the temple and the lower jaw.

The sixth pair, which provides the sense of touch for the internal parts of the body, starts behind the previous one from the lowest part of the brain, and leaves the skullcap through the open end of the suture named the lambda. It comes out immediately with a number of small branches, which nature has bound up as a unit in one surrounding membrane, for greater security. Consequently although they appear one to the careless eye, right from the start they are really as numerous as the [body] parts to which they are due to be distributed, and twelve or even more are found on careful scrutiny. During their passage through the neck they are all seen as practically linked, in association with the local arteries. But as they proceed further they divide into two. One group departs inwards over the roots of the ribs, tethered by membranes, and thence proceeding downwards lies on the inside of the lumbar muscles, following this path until the end of the sacrum is reached. In the course of this long path practically all the intestines and viscera below the diaphragm, the spleen, the kidneys, the bladder, the testicles, and all of the peritoneum have received some fine branches, mediating touch to them, because it was appropriate for them to acquire this sense directly from the cerebral nerves. But in the downward journey, the [P29] spinal medulla gives off nerves harder than these from its nearby situation, so that from the mingling of the two lasting strength and stability got woven in with the sense of touch. The other nerves of this pair turn

ad oesophagum inclinant, cui vtrinque connexi assistunt, paritèrque demissi ori ventris se impingunt, in reliquum eius corpus adusque fundum disiecti, in exilésque exhausti tenuitates. Syncera autem est haec propago, nequaquam durioribus nervis vti superior implicata. Nihil ab hac ne minimùm quidem septo transverso impartitur: ad caeteras autem partes, oesophagum, asperam arteriám, pulmones, cor atque iecur, in transitu villi quidam emergunt ac dimanant, adèò vt principes hae partes quibus gubernamur, synceris istis è cerebro nervis praeditae sint et instructae, continuatáque cognatione sibi consentiant. Ab hac propagine vbi iam in thoracis spatium aliquantum processit, rami quidam retorquentur ad laryngis musculos: súnque ij nervi recurrentes, de quibus abundè suprà dixi. Septima postremáque coniugatio ab extremo cerebri erumpit, quà iam spinae medulla elabitur: inde cum sexta digreditur, maximáque parte in villos musculorum linguae interiores soluitur, quos ipsos multifariam intexit. Minima quaedam huius coniugij portio in rectos laryngis musculos effertur: alia verò neque ea modica in primos amplósque lacertos, qui scapulas sursum adducunt: alia denique in eos qui tonsillas ac fauces inuoluunt. Quocirca rectè videtur haec neruorum linguam mouentium coniugatio dici, quam reliquis sicciorémque duriorémque haberi ipsa planè origo commonstrat. Hae sunt omnes è cerebro neruorum origines atque progressus. Iam verò ne quid eorum quae ad caput pertinent, desideretur, de sensuum instrumentis tempestiuè híc agendum duxi. Auris ad auditionem introitu semper patet duro, et multis anfractibus flexuoso, ne sonus derepente affatímque intrò subiens sensum laedat. Nam imum anfractum crassior meninx succingit et obducit: audiendi autem neruus in eam ipsam membranam fusus explicatur, quae for-
amini per transversum obiecta, inuectum sonum ictúmque aërem excipit, defértque in cerebrum commune sentiendi principium. Extrà autem quae appellantur auriculae prominent cartilagosae, multísque flexibus externis iniuriis oppositae, ne quid ex inopinato intrò irrueret, néue appulsae voces laberentur atque errarent, pars superior eáque durior pinna dicitur, inferior quae mollis, fibra.²¹ Nasus homini tantùm altior eminentiórque in facie, quo quasi integumento nares occultantur, tum odorum spiritúsque via, tum mucosae eluuiei emungendae riuus. Illàc siquidem hausti ductíque spiritus pars tracta irrepit in cerebrum,²² pars in asperam arteriam et pulmones rapta delabitur. Nares aequè disterninat interseptum cartilaginosum,

towards the esophagus; they run linked with it on each side, and passing down together fasten upon the mouth of the stomach, dispersing into the rest of its body as far as the bottom and ending in slender threads. This system is on its own, not mixed at all with harder nerves like the previous one. It makes not the least contribution to the diaphragm, but as it passes, hairlike processes come out and spread to the other parts: esophagus, trachea, lungs, heart, and liver, so that the main organs that control us are equipped with these purely cerebral nerves, and make common cause through their unbroken relationship. When this outgrowth has progressed some distance into the chest cavity, some branches retrace their steps to the laryngeal muscles; these are the recurrent nerves, about which I spoke at length previously.

The seventh and final pair sprouts from the lowest point of the brain, where the spinal cord is already emerging from it. It starts out from there with the sixth pair, and mostly vanishes into the internal filaments of the lingual muscles, interwoven with them in a complex fashion. A very small portion of this pair runs out into the straight muscles of the larynx; another substantial portion into the sizeable major muscles that pull the scapulae upwards [trapezius and levator scapulae, supplied by the accessory nerve]; a final portion into the muscles that enclose the tonsils and throat. So this pair seem correctly named the pair of nerves that move the tongue, and its very origin clearly indicates that it is drier and harder than the rest. These are all the origins and paths of the cerebral nerves.

In order not to omit anything relating to the head, I felt that this is the right time to deal with the sense organs. The ear is always open to hear, by an entrance that is rigid and very tortuous, to prevent a sound from suddenly entering far enough to damage the sense. For the dura mater encircles and blocks the innermost bend; the nerve of hearing spreads out widely into that same membrane that lies across the foramen, receives the sound that has entered and the air's impact, and transmits to the brain, the common source of feeling. Externally, the so-called auricles protrude, cartilaginous, and with many windings that resist injury from outside, so that nothing could unexpectedly force its way in, nor could voices impinging on it slip and lose their way. The upper part is harder and is called the pinna: the lower is the *fibra* and is soft.

The nose in man is so much more elevated and prominent on the face, and the nostrils are concealed by its cover; it is both a path for odors and spirit, and a channel for blowing away mucous overflow: part of the spirit that is drawn in travels this way into the brain, and part is seized to slip down into the trachea and lungs. A cartilaginous septum divides the nostrils down the middle, extending

ab imo ad summas nasi angustias et palati superiora protensum. Nam tota haec regio plurimis foraminibus peruia est, per quae cerebri superuacua influunt, in nares quidem per os cui à spongia nomen est, in palatum verò per id quod speciem cribri gerit: tametsi è naribus in fauces communem viam patere ostendunt, quaecunque illinc huc regeruntur imprudentibus nobis. Assistunt vtrinque oculi, pars corporis preciosissima, qui tanquam speculatores altissimum locum obtinent, ex quo plurima conspicientes fungantur suo munere, et eminens quaecunque nocitura sunt, aut profutura prospiciant. Horum gratia (si Galeno creditur) caput in altis editisque partibus corporis collocatum est, quia cerebrum ob breues opticorum neruorum ductus oculis proximum esse debuit, illic sublimi loco positus. Ij vt reliqui sensus gemini parte priore, in quam progredi solemus, in antra concaua reconduntur et latent, vtiliter excelsis vndique partibus circumsepti. Primùm enim à superiore parte supercilia, ab inferiore malae leuiter eminent, et nasus in medio quasi murus oculis interiectus, à dextra et à laeua temporum ossa. Palpebris integuntur mollissimis tactu ne laederent aciem, quarum inferiores fixae et immutabiles conquiescunt, vt et genae inter has atque malas collocatae: superiores pupulas claudunt, ne quid obiter incidat, easque aperiunt cum celeritate maxima. Palpebrarum extrema cilia sunt, dura cartilagine firma, quae ταρσὸς appellatur: huic infixi pili eriguntur, quibus tanquam vallo quodam muniuntur oculi ad leuiorum occursus, hosce pilos Graeci βλεφαρίδας dixerunt. Lubrici facti sunt et mobiles, vt aspectum quocunque vellent facilè conuerterent, ob idque vtrin-[P30] que septem his muscoli circumiecti, è quibus vnus sursum, alter deorsum, duo ad dextram laeuamque trahunt, alij duo illos circumferunt, septimus sustinet et illigat. Ex tunicis quaternis atque ex ternis humoribus conditi sunt. Prima tunica et extima ἐπιπεφυκῶς, id est adnata et adhaerens appellatur, cuius interuentu oculus tenetur et adhaerescit. Altera cornu similis κερατοειδής. Tertia vuae, ῥαγοειδής. Quarta araneorum telae, ἀραχνοειδής. Humorū extimus est ὕδατώδης ab aqua dictus, alter ὕαλοειδής vitro fuso similis, intimus κρυσταλλώδης: omnium autem compositio huiusmodi esse deprehenditur. Adhaerens tunica oculi posteriora contegit excipitque musculos omnes, ex pericranio haec quidem nata: proximè illi adhaerescit cornea vniuersum oculum vndique cingens, quae tametsi à dura cerebri meninge profiscitur, quàm illa tamen durior

from the bottom to the narrows at the top of the nose and to the upper parts of the palate. The whole of this region is traversed by very many foramina, through which the surpluses of the brain flow in: into the nose via the bone named from a sponge, but into the palate by the bone resembling a sieve. And yet an open common path from the nostrils into the throat is demonstrated by all that is brought back along that path through our oversight.¹⁰⁵

On each side are the eyes, a most valuable component of the body, which like sentinels occupy the highest point, and from there they carry out their task by seeing as much as possible, and picking out from a distance whatever is going to do good or harm. If we are to believe Galen,¹⁰⁶ it is for their sake that the head is situated in the most elevated point in the body, because the channels of the optic nerves are short, and the brain required to be close to the eyes in their lofty position. Twin like the other senses, the eyes lurk in recesses in front, the direction in which we generally move, and are ringed advantageously by prominent parts all around: firstly the eyebrows protrude above, [then] the cheeks protrude below a little, the nose is like a wall in the middle between the eyes, and the temporal bones are to the right and left. The eyelids covering the eyes are extremely soft so as not to damage the cornea by contact; the lower ones rest immobile, as do the cheeks between them and the cheekbones; the upper ones cover the pupils so that nothing can happen to get in, and open them very fast. At the edge of the eyelids are the eyelashes, set in a firm cartilage called a tarsus; from their anchorage there the hairs stick out like a rampart guarding the eyes against the approaches of small particles ["leviora"]. The Greeks called these hairs *blepharidas*.

The eyes are slippery and mobile, so that they can readily turn the gaze wherever they wish, and for this have [P30] seven muscles on each side surrounding them: one pulling them up, one down, two to right and left, and two others rotate them, while a seventh supports and fastens them in. Each eye consists of four coats and three humors. The first and outermost is the "epipheukos," that is, annexed and adherent;¹⁰⁷ it enables the eye to stay in place. Another is the "keratoeides," that is, hornlike [cornea]. The third is the uvea, "ragoeides" [grapelike]. The fourth is the spiders' webs, "arachnoid" [retina]. The outermost humor is "hydatodes" so named from water [aqueous humor]; the next is the hyaloid, like melted glass [vitreous humor], and the innermost the crystalloid [the lens]. The makeup of all eyes is found to be like this. An adherent coat, derived from the pericranium, covers the back parts of the eye and encloses all the muscles. The cornea is closely attached to it and runs all around the eye. Although it is derived from the *dura mater*, it presents a harder

firmiórque externis rebus obiicitur, pellucida quidem, vt per eam cerni posset. Hac concluditur humor ab aqua aut ab oui candido nomen habens, quem mox ῥαγοειδής vniuersum comprehendit. Quoniam verò haec tunica à posterioribus partibus corneae propemodum adhaerescit, à prioribus autem longissimè distat, idcirco his conceptus humor totus penè in priora confluit. Vt granum vuae sic ῥαγοειδής parte priore et media foramen habet, quod púpula Latinè, κόρη et γλήνη Graecè vocatur, è quo acies est qua cernimus, hoc enim rerum spectra spiritúsque prosiliunt: nascitur autem haec ex tenui meninge. Rhagoidem circumcirca proximè succingit arachnoides, colore nigra, arteriis venisque conspersa more secundarum vteri, ex videndi neruo tenuissimè fuso dilatatóque nata, qui ex cerebro nonnihil secum detulit eius contextus, qui χοροειδής appellatur. Itaque inter has tunicas palàm est nihil prorsum intercedere. Quantum superest interioris capacitatis, id replet vitreus humor copiosissimus, is quidem et crassitie vitro fuso similis: in quo proinde crystallinus veluti innatans stabilis et constans insistit, nulla tunica diremptus. Positus autem is est non in vitrei medio, sed parte eius priore, púpulae prorsum obiectus, vt ea sede medium totius oculi velut punctum occuparet. Humorum hic durissimus glaciem concretam aut crystallum referens. Figura non planè globosa, sed quà púpulam spectat pressior ac planior. Alitur vitreo humore, vitreus autem per venas è cerebro cum arachnoide deriuatas. Haec de videndi sensu. Gustatus ore continetur vndique septus ad vsum et incolumitatis custodiam, quódque cibi et potionis iudex sit. Quocirca lingua et palatum eius instrumenta cùm sint,²³ satis videntur antè suis locis explicata. Tactus toto corpore aequabiliter fusus est, cuius idcirco propria instrumenta non priùs definire possim, quàm reliquorum omnium neruorum propagatio sit absoluta.

De neruis. Cap. X.

Partium dissimilium instrumentorúmque corporis omnem iam videor compositionem planam fecisse, vt omnis illarum descriptio facta explicatáque putetur: nunc autem ad similarium partium expositionem reuersus, eas primùm verbis amplectar et expediam, quarum beneficio reliquae omnes indigent, communíque opera gubernantur: hae sunt venae, arteriae, et nerui. De his quidem suprà, obiter duntaxat,

firmer surface to the outside world, but a transparent one, through which sight can occur. This confines the humor that derives its name from water or from white of egg, which is next entirely enclosed by the uvea. Since this coat is more or less attached to the back of the cornea, but is far removed from its front, practically all of the humor they hold has flowed forwards.

Just like a grape stone, the uvea has an opening in the middle in front (in Latin named the pupil, and in Greek kore and glene), from which comes the gaze by which we see. By this opening the images and spirits of things leap forth.¹⁰⁸ It originates from the pia mater. The uvea is closely lined all around by the retina, which is glossy black, and scattered with arteries and nerves like the afterbirth of the womb. It is derived from the nerve of seeing, which spreads out extremely thinly, and brings with it from the brain something of the structure called the choroid [plexus]. Thus clearly nothing at all separates these two coats.

The rest of the internal cavity is occupied by the large supply of vitreous humor, which is thick like molten glass. Similarly, within the vitreous swims, so to speak, the crystalline humor, firm and unchanging, not separated off by any coat. It does not lie in the middle of the vitreous, however, but in its front part, closely applied to the pupil, a situation at the central point of the whole eye. This is the hardest of the humors, like stiff ice or crystal. Its shape is not perfectly spherical, but somewhat compressed and flatter where it faces the pupil. It is nourished by the vitreous, and the vitreous by veins originating from the brain with the retina. This ends the account of the sense of vision.

The sense of taste resides within the mouth, enclosed all round for the purpose and preservation of safety, and because it is the arbiter of food and drink. Consequently, since the tongue and palate are its instruments, they have evidently been adequately discussed before in their place. Touch is evenly dispersed over the whole body, so that I cannot define its particular instruments until the distribution of all the other nerves has been covered.

Chapter 10. The nerves.

I THINK I have now made clear the whole makeup of the dissimilar parts and the instruments of the body, so that their complete description may be regarded as covered. Now, returning to the discussion of the similar parts, the first ones I shall embrace and explain with words are those on the bounty of which all the rest depend, being controlled by their shared activity. They are the veins, the arteries, and the nerves. The nerves have already been mentioned, but only

et vt dicere solent perfunctoriè dictum: nunc verò plenam absolutámque illorum propagationem exponemus, qua legentis animus saturari possit. Ne autem de coepto viae cursu deflectam, quam de nervis paulò antè suscepi tractationem hìc persequar. E cerebro tanquam è radice caudex, profunditur spinae medulla, quae cerebri substantiam accipiens, eius aut pars est, aut profectó vicaria, tanto durior quanto longiùs processerit. Vt enim prior cerebri pars vsquequaque mollis est et tenera, posterior tantum dura quantum progreditur, ita sentientes nervos natura omnes è priore illa parte, mouentes verò vtpote duriores et ad motionum impetus sustinendos roboris plurimum nactos, à posteriore et ex spinae medulla deriuauit. Conuenit enim vt è simili vnumquodque nascatur, víxque à duro potest molle quicquam proficisci, quanquam durum quippiam ex molli prodit, non primo quidem statim exortu, sed dum progressus longitudine aut regionis per quam ducitur sicciore natura arescens, durius [P31] robustiùsque se ipso redditur. Sic enim suprà proditum est, complures è tertia coniugatione mouentes nervos emersisse, et è sexta recurrentes, qui longo viae tractu, mouentium vim et naturam acceperunt. Attamen neque hos inter exquisitè duros collocare possis, quòd ab illorum robore plurimùm desciscant, vt idcirco ratum sit et constans omnium exquisitè durorum, cerebellum et spinae medullam principium esse et originem: de quibus iam pleniorē orationem instituo. Itaque medulla per spinae fistulam in extremum sacri ossis progrediens, duobus inuolucris conuestitur, quae à cerebri meningibus proferuntur, et quae eundem ac meninges vsum praestant. Supra haec tertia quoque tunica fortis atque nervosa circumiicitur, ne dum spina inflectitur, flexa quoque medulla disrumpatur. Sequuntur vertebrarum nodi, vinculis suis inter se connexi atque coniugati: quos praeterea vniuersos alia tunica extrinsecus integit et firmissimè colligat. Hìc missum facio tenacem et glutinosum humorem, quo plurimo vertebrae ad motus procliuitatem circumfusae sunt. Medulla igitur tanquam caudex ramis plurimis fruticatur, in omnes artus, sensus, motùsque gratia propagatis: à singulis quippe vertebris bini eo quem nunc dicturus sum modo, expromuntur atque proferuntur. Prima atque summa hinc surgens coniugatio, exilium est neruorum, qui ex medulla orti per obscura summae vertebrae foramina prodeunt: quòd non vt reliquos omnes per articulos compagésque elabi tutum esset, vt qui tenues frequenti

incidentally, and (in a popular phrase) perfunctorily. Now we will explain their distribution fully and completely, so that the reader's mind can be satisfied. Not to deviate from the course I have set, I will follow up here the account of the nerves that I gave a little earlier.

Like a stem from a root, the spinal cord issues forth from the brain, and as it receives cerebral substance, it is either a part of the brain, or a surrogate for it, growing harder the further down it has gone. The front part of the brain is soft and delicate at all points, but the back part is hard according to its progress; thus nature has drawn out the sensory nerves from the front part, but the motor nerves from the back part and from the spinal cord, since they are harder and possess plenty of strength to resist the impacts of movements.¹⁰⁹ For it is appropriate for everything to originate from its like, and a soft thing can hardly arise from something hard, although a hard thing stems from something soft, not however right at its very origin, but by growing progressively [P31] harder and stronger, either because of the length of its course, or because of drying from the more arid nature of the region it traverses. Thus it was stated earlier that several motor nerves that had emerged from the third pair, and the recurrent nerves that had emerged from the sixth pair, did in their long course acquire the force and nature of motor nerves. But you could not reckon the recurrent nerves among the extremely hard nerves, because they fall far short of the strength of the others, so as to establish permanently that the cerebellum and the spinal cord are the source of all the extremely hard nerves, of which I now start a fuller discussion.

The spinal cord as it runs through the spinal canal into the end of the sacrum is enclosed in two sheaths, which extend from the meninges of the brain, and serve the same function as the meninges. On top of them is a third surrounding coat, strong and nervous, so that when the spine bends the cord is not bent too and torn apart. Next come the vertebral bodies, linked together by their ligaments, and another further coat outside covers all of these and binds them strongly together. Here I pass over the sticky and viscous humor that in large amount surrounds the vertebrae to facilitate their movement.

So the spinal cord is like a stem sprouting many branches, which run out into all the limbs for sensation and motion; from each vertebra a pair emerge in a manner I will now explain. The first and topmost pair arising from here consists of slender nerves, which spring from the medulla and emerge through inconspicuous foramina in the topmost vertebra. The reason is that they could not safely make their way out like the others through the joints and connections, since, being thin, they would be torn and crushed by the frequent

motu diuulsi frangerentur. Pusilli autem cùm sint, non extra musculos huic vertebrae incubantes procurrunt. Altera συζυγία insigniores neruos ab ea mittit regione, quae inter primam secundámque vertebra à lateribus posita est. Horum pars maxima circum aures, et in capitis posteriora ad summum vsque verticem effunditur; pars reliqua in circumiectos omnes musculos irrepit, primae implicita coniugationi. Ex his foraminibus quae inter secundam et tertiam vertebra vtrinque hiant, alia proficiscitur coniugatio, ad eos musculos sese applicans qui maxillas mouent, et ad eos qui caput retrò deflectunt, atque haec est tertia. Huic quarta confusa in musculos effertur capiti ceruicique communes, quorum est caput retrò detorquere: in eos praeterea qui maxillas mouent, in eas denique particulas quae ponè aures sitae sunt. Erumpit autem ex eo foramine quod inter tertiam et quartam vertebra intercedit. Quinta coniugatio simul atque è proximo articulo prodierit, altera propagine quartae permiscetur, similiter ac ea distributa: altera verò sextae. Haec autem post quintam vertebra excidens, ad scapulas plurimùm deriuatur: insuper verò proximis vtrinque sese attexit, et tenues de se villos in singulas ceruicis vertebra emittit. Eadem quoque diaphragmatis neruo implicita atque inserta, non modicè eum adauget et amplificat. Qui enim diaphragma moturi sunt nerui, è ceruicis medulla omnes prodeunt, plurimi autem vt multis visum est ex quarta coniugatione. In partem diaphragmatis mediam quae neruosa est et musculi principium censetur, hi se penitus inserunt: in ipsaque via fulciuntur intersepiente membrana thoracis. Duo alij per initia his copulantur nerui, qui tamen mox inde intrò sub os pectoris euecti, tandem in diaphragmatis summum et ad mali punici sedem contendunt: horum eadem origo quae superiorum est. Septima coniugatio sub vertebra sexta emergens, maxima ex parte in brachium porrigitur: villi autem reliqui proximis implicantur annectunturque in caput, in ceruicem et diaphragma diffusi. Similis propemodum et octauae coniugationis distributio, cuius tamen in cubitum et vlnam multiplex processus, totus absumitur nec vltrà pergit, attamen huius nihil quicquam in septum transversum promouetur. Nona post octauam vertebra nata, in manus extremas tota properat, hoc dempto quod superior sibi adiiciens quasi arripuit: sed huius quoque nonnihil abit in vicinum musculus, qui primus atque summus in thorace, medium inter primam secundámque costam spacium tenet. Itaque nona haec productio cùm ad cubiti flexum carne quidem nudum se appulerit, ne fortè periclitaretur, inter ossium tumores atque nodos se abdidit,

movement. And as they are very small, they do not extend beyond the muscles lying on this vertebra.

A second pair sends out more conspicuous nerves from the lateral gap between the first and second vertebrae. Most of these are distributed around the ears and into the back of the head right up to the crown. The rest makes its way into all the surrounding muscles, interwoven with the first pair. From the foramina opening on each side between the second and third vertebrae another pair makes its way, attaching itself to the muscles that move the jaws,¹¹⁰ and to those that bend the head backward; this is the third pair. A fourth pair mingles with the third and runs out into the muscles common to the head and neck, which serve to twist the head back, and especially into those that move the jaws, and finally into the parts behind the ears. It sprouts out from the foramen between the third and fourth vertebrae. As soon as the fifth pair gets out from the next joint, it has one branch that mingles with the fourth and is similarly distributed, and another that mingles with the sixth.

The sixth, slipping out behind the fifth vertebra, mostly proceeds to the scapula, and also interweaves with its neighbors on each side, and sends out fine threads into individual cervical vertebrae. It is associated too with the nerve of the diaphragm, and contributes substantially to it. The nerves that are to move the diaphragm all stem from the cervical spinal cord, and most of them from the fourth pair, as many people have noticed. They are inserted inside the central part of the diaphragm, which is nervous and is reckoned the key part of the muscle. On their way they are supported by the mediastinum. Two other nerves are linked with these at their starts, but soon leave to make their way inward under the sternum, finally reaching the top of the diaphragm and the bed of the xiphoid process; they have the same origin as those already mentioned.

The seventh pair, emerging under the sixth vertebra, mostly passes to the arm; but the fine filaments left behind mingle and bond with their neighbors, spreading out into the head, neck, and diaphragm. The distribution of the eighth pair is practically the same, but its manifold branching into the elbow and forearm is entirely expended there and goes no further. None of it, however, proceeds into the diaphragm. The ninth pair [i.e., first dorsal], starting behind the eighth vertebra, all speeds to the ends of the hands, after losing a part that the next pair above annexed and took over; but some of this goes off into a neighboring muscle, the first and topmost in the thorax, that occupies the interval between the first and second ribs. This ninth outflow, having applied itself to the bend of the elbow where there is no flesh, hid itself between the

illíncque tutò triplici propagine in manum disiicitur, vna quidem intus ad minores digitos, altea in maiores fissa: tertia in summae manus externam regionem inflexa. Caeterum non haec modò, sed octaua quoque et septima dum per humerum fertur, intrò via tutissi-[P32] ma pergit, multis integrentibus musculis communita. Sequitur decima coniugatio, quae ipsa secunda quoque dorsi censerì debet, quemadmodum quae dicta proximè est, dorsi prima statuitur. Etenim vertebra quae omnium est octaua, si eadem quoque dorsi prima ponitur, consequens est eam coniugationem quae sub illa erumpit, dorsi quoque et thoracis primam existimari. Itaque ex singulis quae in dorso sunt vertebrarum compagibus, singula neruorum coniugia in proximos emergunt musculos, tum in eos qui inter costas positi sunt, tum in eos externos qui per spinae longitudinem excurrunt, *ῥαχίτας* hos Graeci vocant. Quin et horum neruorum extrema sese latius demum explicant, dum qui ex verarum costarum radicibus exierunt, in humeros, in scapulas, in circumiectos thoraci musculos, in reliquas demum omnes pectoris particulas tenuissimè fissi sparsíque diffunduntur: qui verò ex breuiorum costarum nati sunt vertebris, in abdominis musculos adeunt. E lumbis quicunque nerui efferuntur, partim in externos posteriorésque musculos perreptant, partim in interiores, iis neruis implicati quos diximus è sexta cerebri coniugatione eodem deriuari. Ex osse sacro quatuor qui vtrinque excidunt, ex suo quisque foramine in crus vniuersum iter habet. Ex quibus colligi potest omnes è spinae medulla tractas coniugationes esse nouem et viginti: octo quidem è ceruice, à dorso duodecim, quinque ex lumbis, ab osse sacro quatuor. Sunt qui ab hoc quinque expromi iudicent, vt sint omnes triginta. Auicennas quoque è coccygis et caudae extremo neruum coniugij expertem deducit: at re vera hic inter vincula annumerandus est, neque praeter eas quae hactenus proditae sunt à nobis, vlla seorsum et per se coniugatio deprehendetur. Sic autem deducuntur, vt qui nerui ex infimis duabus lumborum vertebris atque ex ossis sacri quatuor foraminibus emerunt, omnes ferè in vnum quasi fasciculum coniecti, parte posteriore qua coxa rimam amplam agit, in crura protrudantur ponè articulum, amplo operti abditíque musculo. Simul autem musculis qui inibi sunt, prout fert dignitas atque magnitudo, suum cuique ramum impartiunt. Vnde mox alij in crura sparsi deorsum per interiora feruntur, qui ad pedis inferiora concedunt: alij verò per exteriora in pedis priora

bony swellings and knobs,¹¹¹ to avoid risk, and thence safely dispersed into the hand by a triple distribution: one division to the smaller inner fingers, one to the larger fingers, and a third bent into the outer part of the top of the hand. Not only this pair, but also the eighth, and the seventh as it runs through the upper arm, makes its way internally by a [P32] well-protected path, guarded by many covering muscles.

The tenth pair is next, and should also be reckoned the second dorsal pair, in the same way that the pair just mentioned is regarded as the first dorsal pair. For if the eighth of all the vertebrae is made also the first dorsal vertebra, the consequence is that the pair that emerges below it is reckoned also the first dorsal (and thoracic) pair. And so from the individual junctions between vertebrae in the dorsal region, individual pairs of nerves come out into the adjoining muscles, both into the intercostal muscles, and into the external muscles that run the length of the spine, called *rachitas* by the Greeks. Further, the ends of these nerves terminate by dispersing themselves more widely, while the nerves that have come out from the roots of the true ribs split up into very tiny branches and scatter widespread into the upper arms, the scapulae, the muscles around the thorax, and ultimately into all remaining parts of the chest. But those that originate from the vertebrae of the shorter [false] ribs pass into the abdominal muscles.

The nerves that issue from the lumbar region crawl partly into the external and posterior muscles, and partly into the internal muscles, mingled with the nerves distributed as we mentioned in the same direction from the sixth cerebral pair [vagus nerves]. Four issue from the sacrum on each side, each traveling from its foramen into all of the leg. Hence it can be inferred that all the pairs derived from the spinal cord number twenty-nine: eight from the neck, twelve from the dorsum, five from the lumbar region, four from the sacrum. Some think five come from the sacrum, making thirty in all. Avicenna, too, derives an unpaired nerve from the end of the coccyx and tail; but this is really to be included with the ligaments, and no separate independent pair will be found beyond those that we have dealt with so far. The pattern is that the nerves that have left the two lowest lumbar vertebrae and the four foramina of the sacrum all combine practically into one bundle, and where the hipbone has a wide notch at the back, they run out into the lower limbs behind the hip joint, covered over by a large muscle. At the same time they provide a branch to each local muscle, appropriate to its importance and size. A little further on, other branches run down internally and disperse into the legs, vanishing to the lower parts of the foot. There are others passing externally that belong to the front

atque superiora pertinentes: alij media inter hos regione positi in musculos surae dirempti absumuntur. Id vnum solerter si quid aliud natura prospexit, vt illos ossium, cartilaginum, atque vinculorum quasi propugnaculis cinctos et obuallatos traducat. At verò non omnes qui ex lumbis et ex osse sacro prodierunt, sic continuò per posteriora deorsum commeant, sed ex his non pauci tenues rami per amplum pubis foramen exeunt, alij in exiguos musculos qui circa podicem, vesicam, penem, et testes habentur, alij in peritonaei vesicae et vteri membranas, alij in cutem quae femur circumfundit adusque genu disperstiti. Haec est vniuersa et integra neruorum consecratio.

De venis. Cap. XI.

Iecur venarum esse originem hìc pro hypothesisi constituam, cuius tamen veritatem multis posthac rationibus illustrabo. Huius è parte concaua venae plurimae in ventrem et intestina dispersae finduntur, arboris cuiuspiam radices imitatae. At verò pars conuexa venam crassiorem aedit atque profert, quae arboris caudici comparata ramos admodum multos in omne corpus diffundit: quorum ea vis est et facultas, vt è iecore in omnes partes corporis alimentum distribuant, non modò tuborum ductuúmque similitudine, sed concoquendi quoque viribus insigniti. Praeter reliquas autem attrahendi facultas in illis plurimùm viget, cuius causa in simplici tunica omnes villos in longum porrectos acceperunt: simplex autem tunica satis erat quae sanguinem vtpote crassiorem coërceret atque contineret, neque periculum erat hinc illum diffluere. Iam verò venae omnes hac quae sequitur distributione disiectae dispartitaéque sunt. A iecoris introitu resimáque parte vena grandis excedit (portas appellarunt) à qua velut à communi quodam initio, riuuli complures in ventrem et intestina tanquam à trunco radices aguntur. Ac primum duo ab ipso statim egressu cernuntur, alter minor, ísque superior qui comite arteria multis ductibus totus in ventriculum abit, aliis qui-[P33] dem in ecphysin, aliis in superiora dextráque protensis. Alter riuus multò maior aliàs sub duodenum intestinum, aliàs sub ieiunum se demergens, ídque transiliens in mesaraeon contendit: quod priusquam attingat ei quod pancreas dicunt nititur ac fulcitur, cui sanè et duodenum, et ductus qui ad bilis vesiculam tendit, et reliqua quae inibi sunt vasa inhaerescunt. Ex eo loco riuus in lienem emittitur, qui omnium secundus haberi debet: è quo in transitu venae plurimae capillorum modo tenues in ventriculi fundum permanant. Huius quantum reliquum est,

and upper parts of the foot. Others lying between these lose themselves in the calf muscles. One thing above all that nature has shrewdly arranged is to lead them along under the shielding cover of bones, cartilages, and ligaments. But the nerves that have issued forth from the loins and the sacrum do not all run directly downwards at the back; quite a few thin branches from them run out through the large pubic foramen, some distributed into the little muscles that surround the anus, bladder, penis, and testicles, others into the membranes of the peritoneum, bladder, and uterus, others into the skin that surrounds the thigh down to the knee. This concludes the whole complete pursuit of the nerves.

Chapter 11. The veins.

THAT THE liver is the source of the veins I will take here as an assumption, but will demonstrate its truth later by many arguments. From its concave part very many veins divide up into the belly and intestines, mimicking the roots of some tree. But the convex part gives out a thicker vein, which distributes quite a number of branches into the whole of the body, as the trunk of a tree does. They possess the power and faculty of distributing nourishment from the liver into all the parts of the body, and are notable not just for their resemblance to tubes and pipes, but also for their powers of concoction. The faculty of attraction thrives greatly in them, more than the other faculties, and this is why in their simple coat they possess threads all running lengthwise; the blood being thicker, a simple coat sufficed to confine it, and there was no danger of its leaking out. Now all the veins divide and break up on the following system. From the liver's entrance and bent-back part a large vein (called the portal) leaves, and from it as common origin numerous small streams proceed into the belly and intestines, like roots from a tree trunk. First, two are visible right at its exit: the smaller one is the higher and with an accompanying artery departs as a whole by many channels into the stomach; some of them making for [P33] the ecphysis,¹¹² and others for the upper and right parts of it. The other is a much larger channel, sinking in some cases behind the duodenum, in others behind the jejunum, and passing over it, makes for the mesentery. But before reaching it, it rests upon the support of what is called the pancreas, to which are of course attached the duodenum, the duct that runs to the gallbladder, and the remaining local vessels. From here a channel, which is to be reckoned second of them all, is given off into the spleen. Out of it as it passes very numerous veins as fine as hairs reach into the bottom of the stomach. What is left of it splits into

in lienis substantiam multis quasi radicibus discissum se inserit, quae tamen dum ex liene efferuntur et emergunt, in duos rursum riuulos concurrunt: vnus in os ventriculi parte tumentiore se infert, alter in omenti partem sinistram retorquetur. Tertius è caudice riuus in pancreas primum immersus, mox deinde per mesaraei radicem quae spinae adhaerescit, longo tractu in ilia sinistra procurrit: multisque riuulis dissectus omnem cœli [sic] intestini productionem irrigat, vt proinde ad hoc totus hic tubus pertinere videatur: atque huic quidem isthac deductione comes assidet arteria. Post hunc alius in dextram contendit, per pancreum in duodenum sparsus intestinum, bilis folliculo ferè è contraria regione obiectus. Nihilò hic obscurior superioribus multos quasi surculos in omenti dextram regionem profert, atque è pancreo hi quidem distribuuntur. Reliquus stipes quà iam mesenterium attingit, riuo quinto praedictis obscuriore omnem omenti partem sinistram perreptat. Vbi verò per mesenterium aliquantum iam processit, totus in duos finditur: horum rursus vterque in duos, omnes demum in quamplurimos tenues, quorum pars maxima in gracilia omnia intestina ipsúmque caecum multiplici sobole dispergitur: pars quaedam minor in mesaraei glandulas immissa desinit. Ea est venarum mesenterij propagatio, quae in vnam ad iecoris portas constitutam, omnes tanquam in truncum radices confluunt. Haec porrò iecur mox vt subiit, alios in id ramos spargit, ferè quidem in singulas fibras singulos, sed qui demum sectione partitionéque multiplici in omnem iecoris substantiam exhausti oblitterentur. Quae etenim ab eius conuexo emergit, ampla illa quidem ac proinde caua nuncupata, ex quamplurimis quoque riuulis et quasi radicibus per intimam iecoris partem diffusis, exurgit: at hae nihilominus neque illis quas modò dicebam ex portis in singulas fibras distribui, continuatae sunt, neque ad illas extremitatibus sese applicant, neque aliud quicquam praeter iecoris substantiam illis commune intercedit. Caeterum vena κοίλη, id est caua dicta ipso statim è conuexo egressu, bipartitò finditur, quasi in duos praegrandes ramos dirempta: alter sursum per diaphragma in cor euadit, alter deorsum secundum lumborum vertebrae contorquetur. Ille quidem haudquaquam dorsi spinae insidet, sed per medias thoracis regiones, diaphragmate, intersepiente membrana, corde et pulmonis fibra suffultus, per sublime ad clauas et iugula concedit, plurimósque ramos eo tractu profert ac diffundit: primum in diaphragma duos, qui deinde multifariam fissi longè latèque se pandunt. His proximè exeunt capillorum modo tenues venae, in membranam thoracis intersepientem et in cordis inuolucrum, quarum extremitates haudquaquam paucae, in priores thoracis partes et in malum punicum irrepunt.

numerous roots and enters the substance of the spleen; but the roots on their way out of the spleen unite again into two streams: one makes its way into the mouth of the stomach at the more swollen part, the other bends back into the left part of the omentum.¹¹³ A third stream from the main trunk first sinks into the pancreas and then via the mesenteric root attached to the spine runs out in a long course into the left flank. Divided into many minor streams, it waters the whole length of the colon, so that this whole tube seems to extend just to this [organ]. Over this particular course an artery accompanies it.

The next stream sets out to the right, being distributed through the pancreas into the duodenum, almost opposite the gallbladder on the other side. It is as obvious as its predecessors, and puts out many twigs into the right part of the omentum, twigs that are also distributed out of the pancreas. The stem that is left where it reaches the mesentery penetrates into all the left side of the omentum, by a fifth branch less obvious than the previous ones. But where it has gotten some distance through the mesentery, it divides entirely into two: both of these in turn divide into two, and finally they all divide into very numerous fine branches; most of them are distributed by multiple branching into all the small intestines and the caecum; a minority end up entering the glands of the mesentery. This is the branching pattern of the mesenteric veins, which all, like roots into a tree trunk, run together into one lying at the hepatic porta; this on entering next into the liver scatters other branches into it, practically one to each lobe, but they end by vanishing into the liver substance through manifold subdivision.

The vessel that emerges from the liver's convexity is a wide one and so named the "cava," and takes its rise from very numerous streams and tributaries scattered through the inside of the liver. These however are not continuous with those I mentioned that run from the porta into the individual lobes, nor are attached to them at their ends, and the liver substance is all they have in common between them. The *koile* vein, the so-called cava, splits into two very large branches immediately on leaving the vault of the liver: the first runs up through the diaphragm into the heart, and the second bends back down along the lumbar vertebrae. The first does not lie upon the thoracic spine at all, but passes upward through the middle of the thoracic region, supported by the diaphragm, the mediastinum, the heart and a lobe of the lung, to the clavicles and the neck, and on its way gives off numerous branches: two first of all into the diaphragm, which spread out there far and wide in diverse ways. The next to leave are fine hairlike veins, into the mediastinum and pericardium, with a good many endings that run into the front parts of the chest and the xiphoid process.

Altiùs autem vbi vena caua cordi iam assistit, eam tanquam ramum promit, quae cordis externa ambire spectatur, et in eius molem sparsa exhauriri, vt per quam densior cordis substantia nutriri debeat, non autem eo sanguine quem suis ventriculis conceptum, caloris spiritùsque beneficio tenuiorem fecit atque puriorem. Suprà multò capacior alia in dextram aurem dextrúmque cordis ventriculum demersa illabitur: hanc multis non venam, sed aptiùs membranam dicere placet, ex sinistro venae cauae pariete profectam, quae dextrum sinum inuoluat et obtegit. In cordis corpus non altiùs haec penetrat, neque iam ipso ingressu venae speciem retinet, sed mox vt cor attingit, in illius substantiam degenerat prorsúmque oblitescit: quod sanè argumentum Aristotelicos eò adduxit, vt venas omnes è cordis substantia nasci putarent. Ex hoc cauo dextro venae nouum genus emergit quae in pulmones surrecta, arteriarum modo tunica duplici obuallatur, cuius antè propagationem expediuius. Paulò suprà cordis aurem dextram, caua vena aliam rami specie edit, quae solitaria omní-sque coniugij expers (hinc ἄζυγος Grae-[P34] cis appellatur²⁴) in quintam dorsi vertebam primùm delapsa, mox deinde per spinae longitudinem excurrit in imam partem diaphragmatis. Hanc eandem non paucae corporum dissectiones ostendunt à caua deriuari antequam ad cor accedat. Eadem per spinam incedens vtrinque in omnia interualla costarum ramos effundit, supremis duntaxat duobus aut ad summum tribus exceptis, quae aliunde prodeuntibus venis ali posthac exponemus. Hi autem rami statim è radice et ortu surculos de se foras emittunt in externos dorsi musculos: longiùs verò progressi per costarum longitudinem, tandem extra thoracem foras erumpunt et eminent. Reliqua vena caua contendens ad iugulum, intersepienti membranae à dextera committitur, in quam complures venulas praetenues conspergit: móxque in quinta et minima pulmonis fibra tanquam in substrato puluinari recumbit. At verò priusquam iugulum attingat, totus venae cauae truncus apud glandem, quae inibi ingens conspicitur, in duos amplos ramos dirimitur, qui mox ad axillas festinant inclinati. Huc autem flectuntur per summa et interiora thoracis, cùm nondum supra clauas euecti sunt: excedunt verò et emanant in axillas per id spacium, quod integer clauas et primam thoracis costam intercedit: hinc meritò interiores venae dici solent. Ab his nondum foras elapsis, multae in progressu surgunt vtrinque propagines: primúmque ex eo loco vbi vena caua in duos ramos distrahitur, exiles venae in proximam adiectámque glandem abscedunt: ab ipso deinde ramorum exortu

Higher up, where the vena cava now adjoins the heart, it gives off a branch [the coronary sinus] that is visible surrounding the outside of the heart, and dividing to be spent in its bulk, the firmer substance of the heart requiring to be nourished through it, but not with the blood that was contained in its ventricles, and that the heart thinned and purified by the aid of heat and spirit. Above, a much ampler branch penetrates into the right atrium [aurem] and right ventricle of the heart. Many people prefer “membrane” as an apter term for this than “vein”; it starts from the right wall of the vena cava, to enclose and cover over the right cavity [of the heart]. It penetrates no more deeply into the body of the heart, and ceases already to look like a vein where it enters; on touching the heart it promptly degenerates into cardiac substance and quite conceals itself. This was the evidence that persuaded the Aristotelians to believe that all veins were derived from cardiac substance.

A new sort of vein emerges from this right cavity and rises into the lungs. Like arteries, it has a twin wall, and its distribution was discussed previously. A little above the right atrium of the heart, the vena cava gives off another kind of branch, which is alone and entirely unpaired (hence it is called *azygos* in [P34] Greek); it starts by falling back onto the fifth thoracic vertebra, and goes on along the spine to end in the lowest part of the diaphragm. Quite a number of dissections reveal this same vessel given off from the vena cava before reaching the heart. Running along the spine, it gives off branches on each side into all the intercostal intervals, except the topmost two or the three at the top, which as we will explain later are nourished by veins starting elsewhere. Right from their origin, these branches send out from themselves twigs into the outer muscles of the back, and passing further along the ribs, ultimately extend outside the chest.

The remainder of the vena cava makes its way up towards the top of the chest bone,¹¹⁴ attached to the mediastinum on the right, into which it scatters several very slender veins; next it reclines upon the fifth and smallest lobe of the lung as if upon a couch. But before reaching the [level of the] top of the chest bone, the whole trunk of the vena cava divides into two large branches at the large gland [probably the thyroid; see note 120 below] that can be seen there; they soon make off obliquely to the axillae. To get there they bend through the top of the inside of the thorax, before they have risen above the clavicles. They escape out into the axillae through the unopened space that lies between the clavicles and the first rib; hence they are properly usually called the interior veins. Before they make their way out, many branches arise in their course on both sides: first, from the site where the vena cava splits into two branches, thin veins run out into the immediately adjoining gland; then from the very origin of

alij tenuiores protinus in os pectoris contendunt, eique subditi adusque malum punicum decurrunt, quo tractu in singula costarum interualla partis prioris ramulos explicant: quorum vnusquisque alteri cuiquam venae fit obuius, quam ex illa coniugij experte diximus extremum foras emittere. Iam itaque vtrarumque venarum (tametsi interiores hae sunt) extrema extra thoracem euadunt, tum in mammas, tum in externos musculos inspersa. Praeterea verò ex eisdem amplis ramis insignes venae in tria costarum suprema interualla multifariam diffinduntur: et ex iisdem ferè sedibus aliae mox in scapulas et quosdam interiores ceruicis musculos se conferunt. Post quas aliae emergunt, quae in ceruicis spinam demersae, per interiora foramina supremarum sex vertebrarum irrepunt dum caput attingant. Has igitur propagines effundunt rami ampli venae cauae, priusquam ex thoracis capacitatem excedant. At vero vterque protinus vt de thorace emerit, aliis rursum quatuor quasi surculis fruticatur: quorum vnus in eos externos musculos abit, qui ex humero in medium pectus et supra mammas procedunt, alter in axillarum glandes: atque hi ambo exiles sanè sunt. Tertius in eos musculos se proripit, qui scapulis subiecti sunt, in eumque musculum qui inibi spectatur maximus. Quartus omnium amplissimus externas thoracis partes irrigat et alit, hinc demum ad costarum extrema deriuatus. Occurrunt autem istius propaginis tenues riui extremis earum venarum, quas ab imo et ex intimis thoracis emergere proditum est. Quas autem deriuationes in brachium atque deductiones faciat haec vena interior posteaquam ex axilla exuasit [*sic*; read “euasit” as in 1542 and 1554], paulò post edicetur. Iam verò vt quae supra iugulum in ceruicem et caput inferuntur venae conspicuae sint, ad eum redeamus venae cauae diremptum, quem prope glandem sub iugulis fieri commemorauimus. Ex iis itaque venae cauae ramis, quos tanquam magnos duos stipites in axillas exporrigi dixi, qua parte clauiculis assistunt, vtrinque insignis vna vena surgit in ceruicem. Ante hanc autem alius ramus propior glandi atque citerior emittitur, qui per ceruicis intima deductus gulae vtrinque vnus assidet. Quocirca quatuor ex ea quae sub clauibus est regione venarum propagines sursum contendunt, quas tum primùm iugulares mos est appellare, dum collo insertae sunt et supra claues emerunt. Duae ex his quae pariter cum gula sursum in fauces et oris intima sparsae feruntur, interiores iugulariae dictae sunt, quòd altiùs conditae perpetuò delitescant: aliae autem quae subter cutem existunt, externae et eminentes sunt iugulariae. Harum verò vtraque mox vt à primo exortu supra claues euasit, in aliis quidem corporibus simplex omnino persistit, in aliis finditur in duas, quarum altera priore colli regione

the branches other more slender ones proceed onto the sternum, and run down below it as far as the xiphoid process, while giving off branches to the front part of each intercostal space. Each of these meets some other vein that we said was ultimately given off externally by the azygos vein. And so, although both are internal veins, the ends of both now make their way out of the chest, dispersing both into the breasts and into the external muscles. In addition, conspicuous veins split off from the same large branches into the three top intercostal intervals in many directions; and from practically the same sites others presently travel to the scapulae and some internal cervical muscles. After them others [vertebral veins] come off that enter the cervical spine and traverse the internal foramina of the top six vertebrae until they reach the head. Thus these are the offshoots that the wide branches of the vena cava send forth before they leave the thoracic cavity.

Directly when each has left the chest, it sprouts with four further twigs: one departs for these external muscles that run from the humerus into the middle of the chest and above the breasts, another into the axillary glands; both of these are certainly thin. The third runs onto the muscles that lie under the shoulders, and onto the muscle there that is visibly the largest. The fourth, the largest of all, moistens and nourishes the outside parts of the chest, ending as branches from there to the ends of the ribs. The thin channels of this out-branching meet the ends of the veins that were described as emerging from the lowest portion and internal parts of the chest. I will describe a little later on the distributions made into the forearm by that internal vein after its escape from the axilla.

Now, to make clear the veins running above the top of the breastbone into the neck and head, let us return to the splitting of the vena cava that we mentioned took place beside the gland below the collarbones. From the branches of the vena cava that I described as extending out into the axillae like two large boughs beside the clavicles, a prominent vein rises up into the neck on each side. In front of it another branch is given off nearer, and short of, the gland, and traversing the interior of the neck is applied to the throat, one branch on each side. Thus four venous offshoots run up from the subclavicular region, and are there usually first called jugular when they have entered the neck and come out above the clavicles. Two of these run along with the esophagus up to disperse in the throat and the inside of the mouth; they are named the internal jugulars, because they lie deeper and are hidden all the way. The others lie below the skin, and are the external and prominent jugulars. When each of these has emerged from the clavicles right at its origin, in some bodies it stays completely undivided, but in others splits into two: one at the front of the neck

rectà ad caput ascendit: altera principio quidem deorsum veluti deflexa clauēs circumplectitur: móxque sursum reducit, aliàs soliuaga, aliàs interiori coniuncta. Multi ab ea [P35] riui defluunt, vnus quidem frequenti sobole in proximōs musculos disiectus, alter maior atque obliquior, qui è clauibus sensim discedens, ad humerum per externa deflectit: hanc idcirco venam humerariam et externam mos est appellare: tametsi illic minimè exhausta oblitescit, sed longiùs progressa cubiti flexum petere contendit. Vnde perspicuum est humerariam venam non minore, imò plerumque maiore societate atque commercio cum vena caua coire, quàm cum ceruicis et capitis interioribus. Quin et illam nos plerumque obseruauimus tanquam ramum erumpere atque nasci ex interiore vena, mox vt thoracem egressa ad axillam festinat, vt proinde secta nihil aliud quàm interior illa conferret. Tertius ramus ab externa colli vena productus, et in scapularum musculos deflectens absumitur. Quartus humilis eódem in musculum ingentem demittitur, ei plerumque occurrens venae, quam à basilica in humerum efferri iam diximus. Quod porrò externae istius iugularis reliquum est, quà iam ad aures sese applicat, variè distractum atque disiectum, alios ramos in faciem et tempora, alios circum aures et capitis posteriora, alios intrò in cerebrum diffundit. Sic autem longiùs quoquouersum progredi videntur, vt dextrae venae sinistris, priores posterioribus extremis suis obuiae, in summo vertice concurrant. At qui intrò se inferunt, ad auris radicem quo loco inferior maxilla superiori committitur, viam habent et introitum, quà maximus in cerebrum patet accessus. Interior autem iugularis sursum ascendens gulae assistit vtrinque vna: cùmque iam ad maxillae regionem sese extulerit, iis qui effusi sunt ab externa ramulis alios complures immittit atque coniicit: quique hac confusione implicati sunt, alij in fauces et guttur pertinent, alij in eos musculos qui penitus laryngi circunieiecti [*sic*] sunt, alij insignes in linguam, alij in palatum et circumductas ori partes. Hinc interiores iugulares supra palatum emergunt, ceruicis intima secutae dum capitis basin attingant: quo ductu in eas partes quae inter palatum et basin positae sunt, ramulos effundunt: quorum tandem extrema desinunt in nares. Ex eisdem ferè sedibus ramulus vnus aeditur profertúrque inter primam et secundam ceruicis vertebram: móxque

climbs straight to the head; the other bends down at the start to wind around the clavicles, and soon returns upwards, in some cases travelling alone, in others combined with the internal jugular. [P35] Many small vessels emanate from it: one with frequent branches is dispatched to the nearest muscles, and another, larger and more oblique, departs gradually from the clavicles and bends to the upper arm on an outside path; hence it is usually named the humeral and external vein [Galen's term; now the cephalic vein]. It does not finish and vanish there at all, however, but hurries on further to reach the bend of the elbow. Thus it is evident that the humeral vein has not a less, but as a rule a much greater association with the vena cava than it has with the interior of the neck and head. Further, we have generally seen it spring out like a branch from the internal vein, close to where that vein leaves the chest and hastens to the axilla, so that when opened it would make just the same contribution as the internal vein. A third branch is given off by the external vein of the neck, and inclining into the muscles of the scapula runs out. A fourth is a little vein that proceeds in the same direction into the very large muscle, usually meeting the vein already mentioned that passes from the basilic vein into the upper arm.

The residue of the external jugular vein divides and splits up in various ways where it now approaches the ears, and gives off some branches to the face and temples, some around the ears and the back of the head, and some inside into the brain. They are seen to proceed further in all directions, in such a way that at the top of the head the right side veins at their terminations meet and accompany the left side veins, and the front veins do the same with the rear veins.

But the veins [reading "quae intrò se"] that make their way inside have a path of entry with the widest access into the brain at the root of the ear, where the lower jaw is attached to the upper jaw. The internal jugular on its upward course lies beside the esophagus, by itself on each side; on rising to the neighborhood of the jaw, it puts out a number of other twigs to join those sent out by the external jugular. Of the twigs involved in this union, some extend into the pharynx and throat, others into the muscles that lie deeply around the larynx, other notable twigs into the tongue, and others into the palate and the parts around the mouth.

The internal jugulars come out above the palate here, keeping to the depths of the neck until they reach the base of the skull. On their way they give out small branches into the parts lying between the palate and the base of the skull, branches with ends reaching the nostrils. From about the same region a single branch is given off between the first and second cervical vertebrae, and then

alter inter occiput et primam summámque vertebram, qui tamen hinc elapsus in pericranium quibusdam dissipatur, aliis integer patente foramine in occipitis osse intrò se recondit per meninges ad verticem diffusus: solet haec à quibusdam vena puppis appellari. Reliquae iugularium extremitates, per suturas quae occiput et os cunei copulant euadunt in cerebrum, móxque è basi media eò pergunt, vbi duplicata crassa meninx cerebrum à cerebello dirimit: sicque geminationis illius firmitate suffultae, sursum irrepunt in cerebri summum quasi fastigium, in quo vacua regio inest quam suprà torcular diximus appellari. Quinetiam venae quas dixi ad aurium radicem intrò inuehi et inferri, mox propaginibus multis dispersae, à lateribus media inter caluam et crassam meningem via, in vnum quoque torcular omnes vtrinque commeant. Hic enim locus est in quem cerebri alimentum magna ex parte confertur: è quo demum id riuus tenuissimis, quos iam venas vix ausim dicere, in omnem cerebri substantiam profunditur. Quin et illi riui iuxta cerebri glandem tenuissimè dissecti, in priores ventriculos concedunt, ibique exilibus arteriis implicati, contextum illum struunt atque componunt, qui à Chorio, id est à secundis foetum inuoluentibus nomen habet. Ea nimirum est omnis venarum in caput et cerebrum dispersio: nunc autem ad eas redeundum quae in brachium directè feruntur. Basilica vena quae et interior brachij vena et axillaris appellatur statim vt ex ala excessit, in amplum humeri musculum, et in eos ferè omnes qui illi assistunt, propaginem mittit, inibi penitus exhaustam, reliqua tota aliàs simplex aliàs gemina ad inferiora obliquè deflectit, atque subter cutem emergens ad cubiti nodum festinat. Quò tamen priusquam adueniat, in medium cubiti flexum venam traicit manifestam, ex qua solet ea quodammodo nasci, quam mediam mox appellabimus. Hinc longiùs procedit basilicae truncus, eóque interim viae spacio ramos dispergens in interiores cubiti musculos, subter cutem ad carpum accedit, vbi in venas complures neque eas quidem obscuras diffinditur, quarum fit ad minores inferioresque digitos distributio: è quibus multis nominibus ea celebratur, quae inter medicum²⁵ et minimum digitum interii-[P36] citur. Cephalica altera brachij vena quae eadem externa est et humeraria, à clauibus per

another between the occiput and the topmost (first) vertebra, which in some cases escapes into the pericranium to disperse there, but in others takes cover inside the occipital bone through an open foramen, without dividing, and scatters through the meninges to the top of the head; some people regularly call this the poop¹¹⁵ vein. The rest of the jugular terminations make their way into the brain through the sutures linking the occipital bone and the sphenoid, and then proceed out of the middle of the base of the skull to where the doubled dura mater separates the cerebrum from the cerebellum; supported in this way by this strong twin layer, they pass upwards into the summit of the brain, in which there is an empty region that we said above was called the torcular.¹¹⁶ Further, the veins that I said made their way inwards at the root of the ear scatter presently in many branches, and taking a middle path from the sides between the skullcap and the dura mater, all run together into one torcular. For this is the place into which the nutriment of the brain is mainly gathered; the nutriment is then poured out from it into the whole of the cerebral substance, by very thin vessels that I would hardly dare to call veins. Furthermore, these vessels are split up very minutely near the cerebral gland [the pineal], pass into the anterior ventricles, and enmeshing there with slender arteries, create the structure [the choroid plexus] that is named from the chorion, that is, the afterbirth that enwraps the fetus. This concludes the complete distribution of the veins into the head and brain; let us now return to those that run directly to the forearm.¹¹⁷

The basilic vein, known both as the internal vein of the forearm and as the axillary vein where it has just emerged from the armpit, sends an offshoot into the large muscle of the upper arm and into almost all those that adjoin it, an offshoot that finishes there internally; all the rest of the vein, in some cases single and in others duplicated, turns obliquely downward and becomes subcutaneous as it speeds to the knob of the elbow [it passes in front of the medial epicondyle]. But before getting there, it gives off an obvious vein across into the center of the bend of the elbow, from which originates in a particular way the vein we will shortly call the median vein. The basilic trunk goes further on here; during this part of its travel it distributes branches into the internal muscles of the elbow, and proceeds subcutaneously to the wrist. There it divides into several obvious veins, distributed to the smaller and less important fingers; one of these veins is well known under many names and is [P36] interpolated between the ring and little fingers.¹¹⁸

The cephalic vein is the other vein of the forearm and also lies on the outer side of the upper arm. It follows a winding course from the clavicles through

ceruicis musculum flexuosa declinat in humerum, à quo mox recto tramite deorsum contendit, simúlque venas praetenuas spargit in partes eas quas peragrat. Cùm autem in nodum cubiti proximè appulerit, tripartitò secta ramum vnum in brachij superiores musculos recondit: alterum in cubiti flexum obliquè detorquet, qui manifestè conspicuus cum altero coitionem facit, quem nunc diximus eò quoque è basilica traïci: fitque istarum congressu media quaedam vena, omnium in cubito extantium maxima. Tertium autem ramum efficit reliquus processus, qui per externam cubiti regionem in carpum excurrit, frequentique sobole in superiores manus digitos effunditur: in quibus ea numeratur, quam inter pollicem et indicem consortam, capitis venam dixere. Caeterum media vena è brachij flexu discedens radium ascendit, euadénsque in externa, ramis diffinditur duobus: è quibus alter deorsum deflectens, riuulis basilicae suos quoque permiscet: alter sursum euectus cephalicae ramis se complicat et inserit. Haec venarum esse solet in brachium et manus distributio, quae tamen in non paucis variari cernitur, et nonnunquam eiusdem hominis in dextro ac sinistro dispar. Plerunque vena nulla existit media, est qui cephalicam, est qui basilicam in apertum non proferat: deprehensum quandoque eam quae pollicis assistit à basilica, eam autem quae minimo digito accumbit à cephalica deriuari: tanta videlicet in iis ostenditur naturae varietas, ad quae nulla necessitatis lex cogit: atqui non in venis vt neque in stirpibus vna semper et similis est necessaria fruticantium ramorum proiectio. His omissis tempestiuum iam fuerit venarum inferiorum propagationem explicare. Vena caua simul ac è iocineris conuexo expromitur, ramum ingentem ad inferiora lumbósque contorquet: quos antequam attingit, pendulus is etiam tum et veluti appensus, praetenuas alios ramos in thecas et inuolucra renum, atque in adiecta illis corpora vtrinque profert. Continuò autem vt ille lumbis insedit, in renum corpus eas venas infert, quas dixi iunioribus emulgentes appellari: à quibus plerunque fibrae tenues in ipsa quoque inuolucra concedunt. Ab emulgente sinistra vas exit seminarium, quod multis flexibus in testem sinistram abit: dextrum autem vas non item, sed ex ipsius cauae trunco maiore duci solet. Iam verò cùm sub renes truncus hic peruenerit, ad dextram laeuámque exiles venas spargit in transuersos abdominis musculos, et in omnes ventris partes inanes, quae inter costas adulterinas et suprema coxarum ossa mediae interponuntur. Praeter quas aliae in singulas lumborum vertebrae vtrinque

the muscle of the neck into the upper arm, from where it soon runs down on a straight path, while giving off very thin veins into the parts it traverses. When it has applied itself closely to the knob of the elbow, it divides into three branches and buries one of them into the upper muscles of the forearm; it twists another sideways into the bend of the elbow, where it is readily seen and unites with another just mentioned that the basilic vein sends out in the same direction. Their combination creates a central vein that is the largest of all those in the elbow. The rest of its course makes a third branch, which runs out through the outer part of the elbow into the wrist, and with numerous offshoots emerges into the upper fingers. Among these offshoots is included the so-called vein of the head, lying between the thumb and the index finger.

The central vein, leaving the bend of the forearm, runs along ["ascendit"] the radius, and breaking away to the outer side splits into two branches: one runs down and mingles its streams with those of the basilic vein; the other, running up, entwines and mixes itself with the branches of the cephalic vein. This is the usual distribution of veins into the forearm and hand, but variation is quite often seen, and sometimes left side and right differ in the one human being. Commonly there is no central vein; one case may produce no visible cephalic vein; another no visible basilic vein; sometimes the vein adjoining the thumb is found originating from the basilic vein, and the vein that lies by the little finger is found originating from the cephalic vein. Manifestly so much natural variety is shown where there is no constraining law of necessity; indeed, veins, like plants, do not have one never-changing necessary pattern of sprouting branches. It is now time to pass on and describe the distribution of the lower veins.

As soon as the vena cava emerges from the vault of the liver, it throws out a great branch to the lower parts and loins; but before getting there, while it is still swinging and as though suspended, it gives off very fine branches on each side into the sheaths of the kidneys and the bodies adjoining them on each side. Then immediately, while it rests on the loins [the lumbar vertebrae], it sends into the body of the kidneys the veins that I said¹¹⁹ the younger authors call the emulgent veins. Usually fine threads from these run into the [renal] sheaths as well. A seminal vessel emerges from the left emulgent, and goes off with many bends into the left testicle. But the right vessel differs: it normally stems from the larger trunk of the vena cava itself. Now when this trunk has progressed below the kidneys, it scatters thin veins to right and left into the transverse abdominal muscles, and all the empty parts of the belly that come between the false ribs and the tops of the hipbones. Besides these, others on either side

permeant, per ea vertebrarum foramina se inferentes, per quae diximus nervos foras excidere: atque ex his aliae tenui membrana cinctae in spinae medullam, aliae maiores in eos musculos erumpunt, qui spinae extrinsecus accubant, hinc simul in externa posterioraque corporis longè latèque diffusae. At ipsa vena caua cùm ad postremam vertebram ossisque sacri initium appulsa est et adducta, in duos tota finditur ramos amplissimos, in crura obliquè prolapsuros. Quò priusquam pertineant, plurimas in circumiecta loca coniugationes aedunt: primam quidem retrorsum in ψόας interiores lumborum musculos: secundam exilem in proximas peritonaei partes: tertiam in os sacrum et instratos illi musculos; quartam in podicem et rectum intestinum, in quibus hae numerantur, quas haemorrhoidas prae caeteris nuncuparunt, quanquam inter eas quae ferè septem sunt, vna ex loco medio disiunctionis ramorum venae cauae prodire solet. Quinta coniugatio ad vesicam eiúsque ceruicem flectitur: eadèmq̃ mulieribus ramos alios in vteri fundum, alios in eius partem imam atque ceruicem demittit, qui ipsos quoque testiculos quadam ex parte ambiunt. Sexta in musculos rectos effertur abdominis, per quos dein in thoracis cartilaginem et imam regionem mammarum euadit, extremitatibus occurrens iis venis, quas paulò antè dixi ab axilla in thoracis externa demitti: vnde intelligitur venas quae ad vterum et quae ad mammas prouehuntur, ex eadem aut ex proximis inter se radicibus deriuari. Septima in os pectinis eiúsque lacertos: octaua ex commissa ossium pectinis elapsa, in genitale tum maris tum foeminae pertinet. Nona in musculos crurum interiores figitur: decima subter cutem ab inguinibus per ilium regionem ascendens, iis venis fit obuia quae extrinsecus per thoracis late-[P37] ra deorsum trahuntur. Reliqui amplorum ramorum ductus, in suum quisque crus proficiscitur: atque sub inguine productio quaedam emittitur in priores femoris musculos, per quos sparsa omnis dissipatur: altera subter cutem per interiora femina deerrat, ampla illa quidem et manifesta, à qua complures riuuli in subditas regiones penitus deducti sunt. Haec eadem paulò supra genu tripartitò finditur, ramúmque vnum per priorem et interiorē tibiae regionem recta deiicit in subiectum malleolum, vbi clarus atque conspicuus, saphea dici solet. Alterum maximum per poplitem recondit in abditos atque posteriores cruris musculos, vbi frequenti ramorum sobole disperditur. Tertium per cruris posteriora retorquet,

penetrate into individual lumbar vertebrae, making their way through the vertebral foramina by which we said the nerves emerge; and from these others surrounded by a thin membrane sprout into the spinal cord, and other larger ones into the muscles that lie upon the spine externally; as well, they spread from there far and wide into the outside and back parts of the body.

But the vena cava itself, when it gets pressed against the lowest vertebra and the start of the sacrum, divides wholly into two very wide branches, which slip obliquely out into the legs. Before reaching them they give off very many pairs [of branches] into the neighboring regions: the first pair back into the psoas muscles, the internal muscles of the loins; the second, a slender pair, into the parts of the peritoneum close by; the third into the sacrum and the muscles laid upon it; the fourth into the anus and rectum, among which are reckoned those that are called piles more than all others, despite the fact that among them (there are normally seven) there is generally one that emerges from the central point of the bifurcation of the vena cava. The fifth pair curves to the bladder and its neck, and in women lets fall some branches into the fundus of the uterus and others into its lower part and neck; these partially surround the testicles [ovaries] too. The sixth runs off into the rectus muscles of the abdomen, and through them gets out next into the thoracic cartilage and the lower part of the breasts, with terminations meeting the veins that a short time ago I said passed down from the axilla into the outer parts of the chest. Hence it can be seen that veins running to the uterus and to the breasts originate from the same root, or from closely adjoining roots. The seventh pair goes to the pectinate bone and its muscles; the eighth pair, escaping from the junction of the two pectinate bones [pubic symphysis], reaches the genitalia in male and female alike. The ninth is attached to the internal muscles of the legs. The tenth climbs subcutaneously from the groins through the loin region, to meet the veins that run [P37] down externally through the sides of the chest. Each channel that remains from these large branches travels into its own leg [syntax elastic]; below the groin there is branching into the front muscles of the thigh that disperses itself there entirely. Other branching wanders below the skin through the insides of the thighs; wide and conspicuous, it gives off a number of streams deep into the underlying regions. A little above the knee, it divides into three, and sends down one branch through the front and internal region of the lower leg ["tibia"] into the [medial] malleolus below, where it is usually called "saphea," being distinct and conspicuous. A second branch is very large and passes through the popliteal space to conceal itself among the remote rear muscles of the leg, where it loses itself by frequent branching. A third branch bends back through the rear of the

qui dein sub cute per externam tibiam in subditum malleolum decurrit: longiùs autem progressus, suprà infráque in minores digitos abit, quemadmodum primus extremis riuulis maiores pedis digitos circumplicat. Medius is qui per poplitem abit in suram, ferè bifariam scinditur, et extrema ferè duo disiicit, alterum ad inferiora, in superiora alterum, qui vtrinque assidentium venarum riuulis implicatur. Haec vniuersa sunt quae de venarum distributione atque numero dicenda videbantur: nam quae ex vmbilico in iocineris concaua irrum-punt, vietae iam atque emeritae, in venis habendae non sunt, vt neque in foetuum secundis quaecunque innasci solent et fruticari, corporis partes censeri debent.

De arteriis. Cap. XII.

Arteriarum non longè impar nec dissimilis est atque venarum descriptio. Spiritus enim vitalis in omne corpus effusi, cùm hae canales sint atque ductus, debent vtique in omnes partes corporis deriuari. At nihilominus arteriarum quàm venarum minùs frequens est propagatio, quòd sanguis crassior in exiguas procúlque remotas partes, vix nisi venarum ductibus possit commeare: spiritus autem sanguine multò tenuior ab extremis maiorum arteriarum elapsus, per caecas occultásque partium vias, in distantiora possit euadere, nullo in id arteriae adminiculo indigens. Hinc fit vt arteriam semper vena comitetur, nisi cùm ortus varietas eas coniungi non permittit: arteriam enim quae ex corde secundùm spinam delabitur vena nulla sectatur, vt neque eas quibus contextus ille struitur admirabilis. At non peraequè vnaquaeque vena comitem arteriam obtinuit, tum quòd diuersa origo id plerunque non sinit, tum quòd in complures partes exiguas maximè sub cutem diffusae sunt venae, quibus nulla erat arteriarum necessitas. Itaque insignioribus et magnitudine praecipuis venis, vbicunque natura potuit, comites dedit arterias: quod qua ratione in singulis effecerit, definiendum deinceps breuitérque describendum. Ex laeuo cordis ventriculo vas prodit amplum, quod omnium arteriarum tanquam truncus et stipes habetur: arteriae autem ex eodem in pulmones eiectae, simplici tunicâ venarum modo conditae, huic pro radicibus erunt: iis nempe venis comparatae, quae ex mesenterio in iocineris portas ducunt vehúntque alimentum,

leg, and then runs down subcutaneously through the outer part of the leg ["tibia"] into the [lateral] malleolus below; proceeding further, it departs above and below into the smaller toes, in the way that the first branch winds around the larger toes with its final small streams. The middle branch, which departs through the popliteal space into the calf, generally divides into two, and generally sends off two terminations, one to the lower part, and one to the upper, which is mingled with the streams of the adjoining veins on each side. This is all that seemed called for about the distribution and number of the veins; for those that force their way from the navel into the vault of the liver are shriveled already and have served their time; they should not be reckoned among the veins, any more than those that usually grow and proliferate in the fetal after-birth should be regarded as parts of the body.

Chapter 12. The arteries.

THE DESCRIPTION of the arteries differs little from that of the veins. Since they are the channels for the vital spirit poured out into the whole body, they certainly ought to be distributed to all parts of the body. However, the distribution of the arteries is less dense than that of the veins, because blood, being thicker, can hardly penetrate into tiny and distant parts except through venous channels; but spirit, being much thinner than blood, can slip out of the ends of the larger arteries and make its way through hidden local paths into the periphery, needing no help from the artery in doing so. Thus it comes about that a vein always accompanies an artery, unless a difference in their origin prevents them making common cause. For instance, no vein escorts the artery that emerges from the heart towards the spine, nor the arteries that compose the rete mirabile. But every single vein has not acquired a companion artery in the same way, both because a difference in origin often forbids this, and because veins ramify into a number of small regions, particularly under the skin, which have no need of an artery. Consequently nature provided companion arteries wherever possible for the more notable and strikingly large veins. On what basis she has done this in particular instances will next be explained and briefly described.

A wide vessel leads out of the left ventricle of the heart and is reckoned the trunk and stem of all arteries. But the arteries that run from the same place into the lungs [i.e., the pulmonary veins], and possess a single coat as veins do, will serve as roots for the first vessel. Like the veins that transport nutriment from

sic enim et ipsae ductum de coelo haustumque in pulmones spiritum cordi subministrant. Caeterum truncus is quem dixi, protinus vt è corde prosiliit, duas arterias in illius ambitum reflectit: altera in mediam eius regionem, alteram ad basin circaque dextrum ventriculum. Mox totus in duos eósque dispariles ramos diffinditur: quorum qui amplior, in quintam dorsi vertebra in laeuum torquetur, inferas corporis partes peragraturus: in partes autem superas quòd eae minùs multae essent, minor alter effertur. Hic itaque pulmone sustentatus ad iugulum pergit, ipsaque via ramum profert in alam sinistram, ex quo interim propagines defluunt: vna quidem in tria suprema costarum interualla, quae extra thoracem elapsa ad spinae musculos posteriores sese applicat: altera in pectus et mammas ad extremas vsque costarum cartilagine effusa: tertia in foramina supremarum sex in ceruice vertebrarum, pariter cum vena comite ad medullae membranas adducta. Reliquus hic ramus in scapulam et brachium sinistrum sparsus euadit, basilicam venam plurimùm sequutus. Stipitis autem pars maior ad iugulum contendens, à laeua dextrorsum reflectitur: quae cùm ad ingentem glandem,²⁶ cui ganglio nomen est, peruenerit, ramum vnum ad intimam iugularem sinistram, alterum ad dextram porrigit: externae siquidem venae iugulares, coniuges arterias non acceperunt, vti neque [P38] cephalicae, quas per humerum in brachium proferri diximus. Huius demum arteriae quicquid reliquum est, necdum supra clauas egressum, in dextram axillam iter habet, pares obiter nec dissimiles propagines spargens atque ea quam diximus ad laeuam deflectere. Ex quo perspicuum est, dextrum arteriae ramum longè aeditiorem sinistro existere. Carotides porrò duae arteriae posteaquam supra clauas cum interioribus venis iugularibus in ceruicem emergerunt, sursum rectà festinant, quo tractu in singularum vertebrarum foramina riuulos aedunt, qui medullae membranis impliciti pariter cum illis in caput efferuntur. At carotides ipsae in maxillae confinio bipartitò scinduntur, vt vtriusque pars vna retrorsum et in posteriora, altera in priora et aduersum spectet atque flectatur. Quin et huius duo insuper fiunt rami, alter in linguam et interiores maxillae lacertos, alter foras eminens propter auriculam in temporum musculos effunditur, qui demum in verticem summum ascendens, oppositae arteriae extremis implicatur. Pars verò quam in posteriora flecti dicebam, duos aequè ramos promit magnitudine praecipuos, quorum qui minor apparet per extremum suturae à Λ . nomen assumentis, irrepit in caluam ad cerebelli basin,

the mesentery into the hepatic porta, they supply the heart with spirit drawn up into the lungs from the outside air.

But the trunk I mentioned, as soon as it springs from the heart, bends two arteries back into the heart's periphery: one into its middle, and the other to its base and around the right ventricle. Presently it splits entirely into two dissimilar branches: the larger bends onto the fifth dorsal vertebra on the left, to traverse the lower parts of the body; the other proceeds into the upper parts, and is smaller, since there is less of them, and thus reaches the region of the top of the breastbone, with support from the lung. As it goes it sends out a branch to the left armpit, from which twigs run off as it passes: one to the three top intercostal intervals, which escapes from the chest and attaches itself to the back muscles of the spine; one out into the chest and breasts as far as the ends of the costal cartilages; a third into the foramina of the top six cervical vertebrae, applied with its companion vein to the membranes of the spinal cord. The remaining branch spreads out into the shoulder and the left arm, mostly following the basilic vein. But a major part of the main trunk, making for the region of the top of the breastbone, bends from left to right. When it has reached the large gland called the ganglion,¹²⁰ it gives off one branch to the depths of the left collarbone region, and the other to the right: the external jugular veins did not receive companion arteries, and neither did the [P38] cephalic veins, which we said passed along the upper arm to the forearm.

All that remains of this artery, and has not yet emerged above the clavicle, follows a course into the right axilla, giving off branches on the way that are equal and similar to those of the artery that we said bent to the left.¹²¹ Hence it is clear that the right branch of the artery is much more elevated than the left. Then the two carotid arteries, after emerging into the neck above the collarbones along with the internal jugular veins, speed straight upwards, and in passing send small channels into the foramina of individual vertebrae, which become entwined with the membranes of the spinal cord and pass with them into the head.

The carotids themselves divide in two near the jaw, so that one branch of each faces and turns back to the rear, and the other forward to the front. And the latter gets two further branches: one into the tongue and the internal muscles of the jaw, and the other extending outwards beside the ear and dispersing into the temporal muscles, then rising onto the top of the head and mingling with the ends of the opposite artery. But the part that I said turned backwards gives off similarly two branches of exceptional size: the one that appears smaller makes its way through the end of the lambdoid suture into the skullcap at the base of the

hoc tamen transitu dispersis in partes circumiectas ramulis. Maior ramus partim per id foramen quod ad infimam est auriculam, permeat in caluam, eò quidem deductus vbi geminatio est crassae meningis: partim sursum ad cuneum et cerebri basin euehitur, in multas exilésque arterias diductus, quae variè vtrinque insertae atque implicitae nullius membranae interposito, contextum admirabilem constituunt, cerebri basi substratum, atque in osse cunei reconditum. Ex hoc demum arteriarum contextu tanquam ex radicibus in stipites concursantibus, arteriae duae surgunt, quae per crassae meningis foramina scandunt in cerebrum, mox subtiliùs dispertitae, aliae in cerebri corpus euadunt id ipsúmque ambiunt: aliae in eius ventriculos producuntur, quae assumptis pariter venarum et arteriarum fibris è summo torculari delapsis, contextum illum choroidem componunt. Haec omnis est arteriae in superiora distributio. Ramus alter totius arteriae, à quinta dorsi vertebra in quam ex corde deflexerat, secundum spinam ad os vsque sacrum decurrit, sempérque ad laeuam paulùm declinat, vt oesophago in thorace, et venae cauae per lumbos incedenti, det locum. Primus in tanta productione ramulus editur in eam pulmonis regionem, quae spacium inter quintam vertebrae et cordis basin medium implet, cuius extrema in asperam arteriam sursum adducuntur. Alij deinde rami in singulas vtrinque vertebrae exeunt, quorum propages aliae in costarum interualla proferuntur, in eòsque musculos foras euadunt, qui priori thoraci extrinsecus insertuntur: aliae ferè bifariam sectae partem non modicam ad spinae dorsique exteriores musculos, partem alteram in spinae medullam vtrinque inferunt, per ea foramina per quae diximus venas emitti, neruos autem expromi. Cùm iam septo transuerso assidet arteria, duos in id ramos, vnum ad dextram, ad sinistram alterum transmittit. Sub haec autem ventriculo, iecori et lieni suum cuique ramum impertit: ex eisdem propè sedibus alios in intestina per mesenterium disseminat: nec longè ab his duo praegrandes concedunt in renes, quos nonnullis placuit emulgentes arterias dicere, à quibus fibrae tenues in renum thecas desinunt. Succedunt his arteriarum rami, quarum est in testes transuectio: solet autem quae ad sinistram pertinet, aut tota ab emulgente arteria nasci, aut profectò nonnihil ab ea mutuari: quae verò ad dextram spectat ex maiori trunco proficisci, quanquam est cùm quippiam sumit ab emulgente dextra: procurrun autem et inuoluuntur testibus hae pariter cum venis seminariis.

cerebellum, but giving off branches into the neighborhood along this path. The larger branch penetrates into the skullcap, partly through the foramen that is at the lowest point of the ear, heading for the point where the doubling of the dura mater occurs; and partly it passes up to the sphenoid and the base of the brain, dividing into numerous fine arteries that combine and mingle diversely on each side without any membrane separating them, to form the rete mirabile¹²² that underlies the base of the brain and is hidden in the sphenoid. It is out of this arterial network that two arteries arise, as if from roots gathering into stems, and climb into the brain through foramina in the dura mater; then, dividing more minutely, some branches proceed into the body of the brain and enwrap it; others extend into the brain's ventricles, and take up divisions of both veins and arteries that sink down from the torcular at the top, to assemble the well-known choroid tissue [choroid plexus]. This is the whole of the artery's [aorta's] distribution to the upper part of the body.

The other branch of the whole artery, starting from the fifth dorsal vertebra onto which it had turned down from the heart, runs along the spine right to the sacrum, keeping all the time a little to the left, to give room for the esophagus in the chest and for the vena cava passing through the loins. The first little branch in this long path is given off into the lung region that fills the gap between the fifth vertebra and the middle of the heart's base, and its ends are led up into the trachea. Subsequent branches run out into individual vertebrae on each side, and other ramifications from them extend into the intercostal spaces, and run outside into the muscles that are laid over the front of the chest externally. Other branches split usually into two, and send a substantial part into the external muscles of the spine and back, and another part into the spinal cord on both sides, through the foramina by which, as we said, veins are sent forth [i.e., to enter the spinal canal] and nerves are brought out [i.e., to leave it].

As the artery [aorta] lies on the diaphragm it dispatches two arteries into it, one on the right and the other on the left. Below these it provides a branch each to the stomach, liver, and spleen; nearby it distributes others via the mesentery to the intestines. A little further on, two very large branches depart into the kidneys, which some people choose to call the emulgent arteries; fine divisions from them end in the sheaths of the kidneys. There follow the arterial branches that cross into the testicles: usually the left-hand branch either originates completely from the [left] emulgent artery, or certainly acquires some contribution from it, while the right-hand branch stems from the main trunk, although on occasion it picks up some contribution from the right emulgent.¹²³ Both run forth and are enveloped in the testicles, along with the seminal veins.

Vt suprà de venis attuli, ita et nunc illis comites arterias statuo è singulis lumborum vertebriis ad ilia abdominisque musculos efferri. Perspicuum satis esse potest arteriae truncum, multis ramorum projectionibus maiore ex parte exhaustum, multum iam extenuari atque minui, cum os sacrum attingit: vbi iam totus in duos ramos finditur, quos subiecta crura excipiunt. Atque cum ad hunc vsque locum vena caua vtpote minor et leuior, arteriae ampliori ac densiori incubaret, hic primum in crura diuaticatis illis, arteriarum rami tuitionis causa venis inuehuntur. Ex primis crurum ramis vtrinque arteria vna, adultis quidem arescens et emerita, per quam conceptui vita tenebatur, permeat in vmbilicum. Hinc quoque in os latum et illi adiecta corpora, quaedam excurrunt propagines venis simi-[P39] liter distributae: omnium autem maximè insignes apparent, quae in lumborum musculos interiores, in mulieris vterum, in vtriusque sexus genitale, in vesicam et podicem adeunt. Quaecunque post has in crura deuehuntur, cum venis maioribus altius demersae intima permeant, in ramos effusae et absumptae, qui nequitiam vt venae subter cutem extant. Cum enim illarum quam venarum maior nobis esset necessitas, penitus illas abstrudi atque delitescere tutius erat, et minus crebra propagatione diffundi. Quid igitur simile inter se, quid diuersum acceperint venae et arteriae, ex his perspicuum euadit. Nunc quod integram absolutamque reddat orationem, praestandum atque de reliquis partibus similibus tractatio superioribus nectenda.

De membranis et cute. Cap. XIII.

Tanta inest in corpore membranarum commoditas, tanta necessitas, vt nullam natura partem praetermiserit, quam membrana non integat, comprehendat et fulciat. Siue enim os est, siue cartilago et vinculum, siue musculus atque tendo, adde neruos, venas, arterias, intestina, viscera denique omnia, propriis quibusdam membranis conuestita, et iis veluti conclusa contineri cernuntur. Has quidem ex vsu atque officio, quod veluti tegumenta partes singulas ambiant atque definiant, tunicas propriè dixerunt. Praeter quas tamen aliae quaedam partes disternunt, aliae sustinent, connectunt aliae, quibus commune membranarum nomen est inditum. Ad hoc genus referri minimè possunt tergora ea duo, ex quibus conditus est ventriculus, vt neque ea ex quibus intestina constant atque vterus, vtraque vesica, venae et arteriae: quae quanquam nominis inopia tunicae dici solent, Graecis χιτῶνες, longissimè tamen ab earum quas tradimus natura recesserunt. Illae siquidem propriam ventriculi, vteri, et aliarum quas dixi

As I described above for the veins, I hold that their companions the arteries proceed out from the individual lumbar vertebrae to the loins and the abdominal muscles. It can be readily seen that the arterial trunk, mostly depleted by the many branches it has given off, is already much smaller when it reaches the sacrum. There it divides wholly into two branches, which are received by the legs below. Since the vena cava, on getting here, being the smaller and less heavy vessel, lies beside¹²⁴ the wider and thicker artery, the arterial branches travel upon the veins to protect them at this point where the vessels first part to run into the legs. Among the first leg branches there is an artery running into the navel on each side, which is dried up and disused in the adult, but which used to maintain life for the fetus. From here some branches run into the wide bone [the side of the pelvis, presumably] and the adjoining structures, [P39] on the same pattern as the veins. The most conspicuous of them are those that run into the internal muscles of the loins, into the uterus in the female, into the genitalia in both sexes, into the bladder and into the anus. All the subsequent arteries that run into the legs sink more deeply along with the veins and traverse the interior, running out and being spent in branches that are not at all visible below the skin like veins. Since they were more necessary to us than veins, it was safer for them to be withdrawn into deep concealment, and be distributed with less frequent branching. These points have made it clear what differences and resemblances have been acquired by veins and arteries. Now what will make the account absolutely complete must be provided, and a discussion of the rest of the similar parts must be attached to what has been said.

Chapter 13. The membranes and the skin.

THE BODY derives so much benefit from membranes and has such need of them that nature has left no part without the cover, grasp, and support of one. Bone, cartilage, ligament, muscle, tendon, nerves too, veins, arteries, intestines, indeed all the viscera are seen to be clad in their own membranes, and as it were enclosed by them. This last kind, from their useful function in surrounding and setting bounds to each part, like coverings, have rightly been called coats. Others besides divide parts, others support them, others link them, and share the general name of membranes. The two skins that form the stomach can barely be included in this category, nor can those that make up the intestines and the uterus, both bladders [urinary and gall], veins, and arteries; admittedly they are often called coats for lack of a [better] name, and the Greeks call them chitons, but they have retreated very far from the nature of those we are discussing. It is true that they occupy the special substance of the stomach, uterus and other parts I have

partium substantiam complent. Hae verò partes integrè iam formatas conuestiunt, disterminant aut sustinent. Illae ex propriis fiunt villorum productionibus, quorum ope naturales attractionis, retentionis, aut expulsionis motus obeuntur. Hae nullum villorum genus nouerunt, sed sui vndique similes omnis motus naturalis expertes sunt, solius sensus compotes. Discriminis hoc postremò argumentum efficax, quòd ventriculus, intestina, vterus, caeteráque eius ordinis, cùm ex propriis tunicis tanquam ex substantiis composita sint, hoc tamen insuper membranae genere teguntur, quò firmè cohaereant, teneantur, et sensu polleant certiore. Quas itaque hoc loco propriè membranas appellamus, sunt eae quidem tenues et leues, ne quas obuallant partes pondere suo premant: densae tamen ac robustae, vt arcere possint externas iniurias, ipsamque partium substantiam continere ne fusa dissipetur. Latissima in his differentia spectatur, prout varia est partium quibus addictae sunt natura. Aliae enim simplices sunt tenues et pellucidae, duplices aliae crassae et valentes: figura singulis attributa ex loci et partis quibus accommodantur conformatione. Ex his verò praestantissimae quaeque quibus partes principes obductae sunt et obtectae, proprium nomen acceperunt: reliquarum verò perpaucae. Pericranium appellatur quae caluam extrinsecus ambit, duplex illa quidem et firmissima. At scapulas, costas singulas, humeros, brachiorum, manuum reliquarúmque partium ossa, quaecunque seorsum integunt promiscuè atque communiter περίοστια dictae sunt. Musculum vnumquenque sua quaedam membrana sepit et obuallat, eaque simplex multoque tenuior quàm periostios, cuius vniuersum genus nullum adhuc nomen inuenit. Ex interioribus autem quae cerebrum inuoluunt, meninges appellantur altera crassior, tenuior altera, quarum productiones omnem spinae medullam, ex hácque ductas neruorum propagines circumsepiunt. Supra quas tertia quaedam illis firmior, spinae fistulam intus succingit: itémque quarta extrinsecus vniuersam spinam tegit et illigat. Quae quatuor in oculorum sunt structura, proprias appellationes eas sortitae sunt, quas suo loco explicauimus. Asperam arteriam tum quae intus, tum quae foris continet illiúsque cartilagine connectit, proprio est nomine destituta: similiter quae gulam, quae stomachum oblinat, rursum verò quae vel pulmones, vel iecur, vel lienem, vel denique renes ambit. At verò quae thoracem medium dirimit inter pulmones illapsa, dissepientem membranam appellauimus, eandem qui volet cum Festo dissepimentum nuncupet: cuius ima ex parte pericardium nascitur, [P40] et è summis membrana vtrinque costas succingens ὑπεζωκὼς ὑμῆν²⁷ Graecis vocata. Ita propemodum è peritoneo (quod duplex est infimi ventris membrana)

mentioned. But membranes proper clothe, limit, or support parts that are already fully formed; these other coats are made from filamentous outgrowths, which enable the natural motions of attraction, retention and expulsion to be carried on. Membranes proper are devoid of filaments, and consistently lack everywhere any natural movement, possessing only sensation. To conclude, this is effective evidence of the difference, that the stomach, intestines, uterus, and the rest of this series, made up as they are out of their special coats as materials, are still covered by this kind of membrane as well, which holds them firmly together and provides them with surer sensibility. So we are right to call them membranes here; they are thin and light, so as not to bear down on the parts they cover, yet close-knit and strong, so as to fend off injury from outside, and to hold in the actual substance of the parts and prevent it being scattered abroad. Wide differences are seen between membranes, according to the diverse nature of the parts they belong to. Some are single-layered, thin, and transparent: others are double, thick, and strong; the shape of each being derived from the configuration of the parts to which they are applied. The most noteworthy membranes, and those covering important parts, have been given names of their own, but very few others have. The one covering the outside of the skullcap is the pericranium; it is double and very strong. Those that separately cover the scapulae, the individual ribs, the humeri and the bones of the forearms and hands and other parts are indiscriminately and generally called periosteae. Each muscle is enclosed by its own membrane, a single-layered one, much thinner than periosteum, and the whole class of these has not acquired any name yet. Among the internal membranes, those that surround the brain are called meninges, one thicker and the other thinner, and extensions of them surround the whole spinal cord and the nerve offshoots derived from it. Outside them there is a third stronger membrane, which lines the inside of the spinal canal; and furthermore a fourth one covers and binds together the whole spine. The four membranes in the structure of the eyes have acquired the names we described in their proper place. The membrane that covers the trachea inside and the one that envelops it outside and links its cartilages lacks a special name, as do those lining the throat and the esophagus, and likewise those that surround the lungs, the liver, the spleen, and lastly the kidneys. But the one that has sunk between the lungs to divide the thorax in the middle we have named the mediastinum [*“dissepientem membranam”*], the same one that anyone who wishes can join Festus in calling the *“dissepimentum”*; from its bottom the pericardium originates, and from its top the membrane that surrounds the ribs [P40] on each side, called by the Greeks the undergirding membrane.¹²⁵ In almost the same way other thinner membranes emerge from the peritoneum (the double membrane of the lower belly):

tenuiores aliae prodeunt, tum quae diaphragma succingunt, tum quaecunque ventriculum, intestina, iecur, lienem, renes, vesicam, vterum, omentum atque mesenterium contegunt et obducunt, quibus propria seorsum nulla obtigit appellatio. Membranis omnibus prima origo est ex partium quas inuoluunt substantia atque mole, è qua pingue crassúmque recrementum foras circum illam emergens ac pedetentim siccescens, dum foetus conformatur coit in membranam. Accipit haec robur et omnem sentiendi vim ex neruorum sentientium tenuitatibus in se conspersis contextúque miro consertis et implicatis, vt iccirco à multis falsò existimatum sit omnem membranae substantiam à neruis tractam esse. Caeterum dictorum fidem id confirmat, quòd è sexta cerebri coniugatione conspicuos cernimus neruos sentientes, et in membranam dissepientem, et in eam quae costas succingit illabi: alios quoque in ventriculi, hepatis, lienis contegentem membranam, maximè verò in peritonaeum, è quo demum omnium partium inferiorum tegumenta surgunt. Talis propemodum fieri deprehenditur ad ossium musculorúmque membranas distributio, sed quae tamen sit ab eorum neruorum villis, quos emittit spinae medulla: adeò vt ex his colligere sit membranarum substantiam, tametsi non vniuersa à neruis defluxit, ab illis tamen omnem sensus potestatem accepisse. Haec de membranarum ratione satis. Cutis non dissimilem videtur conditionem sequuta, quae membranarum modo à prima conformatione ex semine concreuit, vt corpus vniuersum obiret atque circundaret, tanto reliquis membranis crassior, quanto corporis vniuersi moles amplior: at paulò rarior quidem effecta, et crebris exilibúsque spiraculis peruia, vt interiorum exhalationi pateret: mediam inter carnem neruúmque naturam adepta, existimari potest ex paribus quodammodo eorum portionibus componi. At reuera propria illius substantia qualem dixi ex semine traxit originem: sed quam tamen subditarum venarum et arteriarum extrema subeunt, quò alimentum spiritúmque profundant. Eòdem neruorum tenuitates è subiectis partibus inferuntur, compluribúsque locis longa propagine conspersi apparent, per quos cuti tangendi sensus asciscitur. Super hanc quae vera est et germana, altera veluti exile tegumentum posita est, quae summa cutis et cuticula nobis, Graecis ἐπίδερμις est. Densior quidem quàm vera, ab exiccatis illius sordibus non ex semine procreata, quam per exustionem ignium vi oborta pustula, conspicuò cernimus à vera cute diuelli, atque in intertrigine discerpi et atteri. Contextu illa perpetuo vniuersum corpus obtegit, nisi quà perforata vel exitum vel introitum praebet in corpus, velut in auriculis, naribus, oculis, ore, genitali, atque podice. Cum subiectis partibus illa quidem minimum habet commercij, sed duntaxat

some surround the diaphragm, some cover over the stomach, intestines, liver, spleen, kidneys, bladder, uterus, omentum, and mesentery, and these have not acquired any separate special name. The original source of all the membranes is the substance and bulk of the parts they enclose, which gives off a fatty dense waste around its outside that gradually dries, and knits into a membrane as the fetus takes shape. It acquires strength and the whole power of feeling from the slender branches of sensory nerves that are scattered into it and interwoven in a remarkable structure, such that many people have wrongly supposed that the whole substance of membrane was derived from nerves. But the reliability of what has been said is established by our seeing that obvious sensory nerves from the sixth pair sink into the mediastinum and into the membrane that undergirds the ribs [parietal pleura]; others too do the same into the membrane covering the stomach, the liver, the spleen, and especially into the peritoneum, from which alone the integuments of all the lower parts arise. A practically similar distribution is found to the membranes of bones and muscles, but such as to come from the filaments of the nerves that the spinal cord puts out. Hence we can deduce that the substance of membranes, though not entirely an outflow from nerves, has acquired all its power of sensation from them. This is enough about the theory of membranes.

Skin seems to have followed a similar course; it condensed like membranes from the first formation out of the seed, so as to cover and surround the whole body, being thicker than the other membranes in proportion as the bulk of the whole body is greater. But it is made a little less dense, and perforated by frequent narrow vents to give passage to exhalation from the inside; with a nature intermediate between flesh and nerve, it can be regarded as made up in a way of equal parts of these. But in truth its special substance as I have described it took its origin from the seed. Yet the ends of the underlying veins and arteries run up into it, to pour forth nutriment and spirit. Nervous filaments from the parts below enter the same way, and are visible in a number of places scattered with lengthy ramification; through these the skin gets its sense of touch.

On top of this genuine skin there lies another, a thin covering layer, that we call the top skin and the cuticle, and the Greeks call the epidermis. It is more compact than the true skin, being produced from its dried refuse and not from the seed; when a blister arises by scorching from the force of fires, we clearly see the epidermis separate from the true skin, and we see it get pulled off and rubbed away in chafing. This fabric covers the whole body all over, except where it is perforated and offers the body an exit or entry, as in the ears, nose, eyes, mouth, genitalia, and anus. It has little to do with the underlying parts, but just sticks to

ex neruorum, arteriarum, venarúmque fibris velut appensa, illis cohaerescit, vt iccirco tota propemodum detrahi possit. Paucae enim partes sunt quae non deglubeantur [corrected to “deglubantur” in Errata at end of the volume]. In fronte sic cum suo musculo implicita cutis coiuit, vt omnem voluntarium illius motum sequatur, qualem et reliqua penè tota facies accepit; vix enim hanc aliud esse iudices, quàm summam musculi faciem vehementer siccata et quasi torrida. Veruntamen in labris non is modò coitus, sed tanta inest confusio, vt neque musculum, neque cutem seorsum queat sensus internoscere. Eius propemodum generis ingenerata est manuum palmis plantisque pedum, tum vt adprehendendi munus quoquoersum aptiùs inflecterentur, tum vt tangendi facultate exquisitiore pollerent: alibi vt dixi nusquam confusa subiectis partibus prorsus adhaerescit.

De carne mollibusque partibus. Cap. XIII.

Solidas atque praeduras corporis simplices partes iam omnes videor attigisse, vt nunc mihi de mollioribus quae carnis speciem habent dicendum supersit. Ne hìc autem à vulgato nomenclaturae vsu discedam, placet id molliorum partium genus vniuersum, vna carnis appellatione complecti. Simplex ea nusquam inueniri potest quae per se ipsa consistat, sed solidioribus [*sic*; correctly spelt in 1542 and 1554] villis adnata atque circumiecta, vi sua et multitudine concretam ex se molem vniuersam, carnis nomine designat [*sic*]. Vniuersi autem eius generis ambitus in [P4r] tres tribui searique solet differentias: vna musculorum est quae propriè caro dici debet, altera glandularum, tertia viscerum quam Graecis *παρέγχυμα* vocari diximus. Musculorum caro tota sanguine madet quo plurimo perfunditur, et vnde suam ea originem duxisse existimatur. Non enim aliud atque sanguis esse videri potest, qui circa villos concreta inanitatè et inter eos mediam implens et quasi infarciens, robur iis accersit et continet, ne per motus periclitentur. Quocirca satis videor de ea transegisse, quum omnem musculorum numerum atque summam recensui: nisi quis praeterea inde discrimina quaedam statuenda putet, quòd alia humida sit, mollis, laxa, rara, aut spongiosa: alia è contrario sicca, dura, astricta, densa, aut compacta. Neque profectò diuersi cuiusdam ea generis (quanuis sit purior) censi debet, quae aut gingiuas, aut maiores oculorum angulos implet, vt neque glans obscoenarum partium in extremo posita. Glandularum porrò ingens est numerus, quae cum omnes ex crassa densaque materia concreuerint, hoc tamen discrimine seiunctae

them through being attached by the threads of nerves, arteries, and veins, in such a way that it can be pulled off more or less whole. There are a few parts that are not skinned: in the forehead the skin is so intimately combined with its muscle as to follow its every voluntary movement, and almost all the rest of the face has got similar skin; you might well take it for the outer surface of the muscle strongly dried and looking scorched. In the lips, however, there is not only this combination, but such fusion that sense cannot distinguish muscle nor skin in isolation. Skin of more or less this kind has been produced in the palms of the hands and the soles of the feet, both to let them bend more conveniently in every possible direction for grasping, and to endow them with a more delicate faculty of touch. As I said, elsewhere the skin is in fact attached to the underlying parts, but can everywhere be distinguished from them.

Chapter 14. Flesh and soft parts.

I THINK I have already dealt with all the solid and hard simple parts of the body, and so it remains for me now to speak about the softer parts that have the form of flesh. To avoid departing here from the conventional use of words, I have decided to include the whole class of softer parts under the one name: flesh. Simple flesh cannot be found anywhere existing on its own, but it grows upon and surrounds more solid filaments; the name “flesh” denotes a whole mass solidified by its own power and abundance [syntax unclear]. What is covered by this whole class is usually divided [P41] into three kinds: one consists of muscles, which ought rightly to be called flesh; another of glands; a third of viscera, which we said the Greeks called *parenchyma*. All the flesh of muscles is wet with blood; a great deal pours through it, and is thought to have supplied its origin. For it is visibly simply blood, which congeals round filaments and stuffs the gap between them full, contributing strength and restraining them so that they are not at risk through movements. Accordingly I think I have covered them enough, now that I have enumerated the whole series of muscles and their ensemble, though there may be someone who thinks that further distinctions should be established: that some [flesh] is wet, soft, slack, loose-knit or spongy; on the other hand other [flesh] is dry, hard, tight, close-knit or compact. Certainly the flesh should not be thought different in kind (though it may be purer) that fills up the gums or the medial [greater] angles of the eyes, nor should the glans on the tip of the private parts.

There are besides a great number of glands, and although they have all condensed from concentrated and close-knit material, they appear as differing

apparent, quòd aliae aliis sunt rariores, neque omnes vna parilisque substantiae ratio comprehendit. Hinc et illarum vsus diuersus euadit, magna varietate distinctus, quaecunque densiores sunt praeter alias commoditates, in locum fissionis tum venarum, tum arteriarum quasi pro firmamento coniectae sunt: quae verò mollitudine sua spongiam quodammodo referunt, eas natura quibusdam vel gignendis vel recipiendis humoribus accommodauit. In hoc genere eae numerantur, quae circa linguae radicem positae, perpetuo quodam munere saliuam eructant: et eae rursum multò maiores, quae laryngi vtrinque assidentes linguam et os subditasque partes madore proluunt. Has latinis tonsillas Graecis *παρίσθμια* appellari diximus. Huic quoque generi ascribuntur, quae in mammis sunt frequentes, laxae, turgidae, dum praesertim lacte circumfluunt, aliàs verò densae et contractae. Finitimi testes his sunt, quorum tamen substantiam ad viscerum rationem spectare credibilis est. Prioris autem generis sunt, in cerebro quidem *κωνάριον*, et glandula pertusa quae supra basin in peluis cauo collocatur, deinde parotides iuxta aures collocatae, et ganglium *θυμὸν* Graecis vocatum, sub iugulo parte summa pectoris: tum praeterea quae in axillis sunt ingentes, tum eae ex quibus *πάγκρεας* magna ex parte conditur: itémque lactes, quo nomine humidas glandulas per mesaraeon sparsas dici volunt, atque insuper quae inguinum capacitatem implent: aliae denique complures quibus vasorum in brachiis atque cruribus diductiones confirmantur, quas sigillatim percensere fastidiosum magis quàm vtile putauit. Sed neque figuram earum aut magnitudinem persequi commodum est, quae cùm sit sua cuique attributa, multiformi varietate distinguitur. Iam verò in parenchymate appellato maior existit dissimilitudo, non modò ex figura atque magnitudine, verumetiam ex sua ipsorum substantia, quae similis et vnusmodi nequit in diuersis inueniri. Ea quidem ex affuso sparsóque humore primo ortu compacta est, vnde rectè affusio dici videtur: at non vt in musculis ex syncero solóque sanguine, sed vel prorsus vel plurimùm ex semine: atque vt varia futura erat cuiusque visceris conditio atque necessitas, ita multiformis est haec substantia comparata. Vnius cordis parenchyma proximè ad muscoli carnem accedit. Hoc tamen diuortio seiunctum, quòd durius multò ac siccus vi seminis circum triplex staminum genus attexitur: illa verò quae in musculo, non item. Ab hoc iocineris propria substantia est, quam concreti atque torridi sanguinis speciem habere putant, cùm tamen palàm sit fieri non posse, vt quod gignendi sanguinis principium statuitur, id ipsum

on the criterion that some are less close-knit than others, and no single similar account of their substance covers them all. Hence their function turns out different, marked by great variety: those that are closer-knit (besides other advantages [they contribute] are gathered into the places where veins and arteries split, as if to reinforce them; those that rather resemble sponges in their softness have been devoted by nature to the generation or reception of certain humors. Of this kind are reckoned those that lie around the root of the tongue and gush out saliva in an unending task, and those too that are much larger and from their location on each side of the larynx flood the tongue, the mouth, and the underlying parts with moisture. We said that they are called tonsils in Latin and paristhmia in Greek. Of this kind too are reckoned those that are plentiful in the breasts, and are loose and swollen when they are particularly overflowing with milk, but at other times are close-knit and contracted. The testicles are closely allied to these, but their substance is more plausibly considered in relation to the viscera. Of the earlier kind [i.e., glandular flesh rather than visceral flesh] there are in the brain the pineal and the perforated gland [pituitary] lying above the brain base in a shallow cavity; then there are the parotids beside the ears, and the ganglion called the thymus by the Greeks, under the throat on the top of the chest; then too the very large ones in the axillae, and those of which the pancreas mostly consists. Also there are the “lactes,” the name by which people mean the wet glands scattered through the mesentery, and besides those that fill the groin cavity. Finally, there are several others that strengthen the branchings of the vessels in the arms and legs; I felt that to enumerate each one would be more fussy than useful. It is not convenient to go into detail about their shape or size, since each has its own, differing very widely from each other [syntax precarious].

Now in what is called parenchyma there is greater variability, not only of shape and size, but also of their own substance, which cannot be found similar in various instances. It is created at its origin from sprinkled humor, so that it is correctly called an affusion,¹²⁶ not however from pure blood alone, as in muscles, but completely or mostly from the seed. And as the character and requirements of each viscus were going to differ, so this substance is made of many sorts. The parenchyma of the heart alone closely resembles the flesh of muscle, but diverges in this, that it is harder and drier and is woven by the power of the seed around a triple kind of warp. The flesh in muscle is not like that. From this [parenchyma] is derived the special substance of the liver, which people think has the form of congealed and scorched blood, although it is clearly impossible that what is the accepted original source of blood should itself be condensed

prorsus ex sanguine concreuerit. Ex quo enim sanguine? cùm nullus ne maternus quidem, in foetus vtero gestati corpus addi aptarique possit, qui non antè sit iecoris eius opera confectus? Renes atque testes quanquam glandularum naturam exprimere videntur, in hoc tamen genus parenchymatis ascisci debent, vt qui non glandularum more arteriis atque venis robur et firmitudinem addunt, sed eximia vi pollent, qualis est à semine nostri ortus initio, visceri sua cuique concessa. At lienis substantia propiùs quàm illi carnis naturam aemulatur: deinde verò pulmonis, vt idcirco in dubium venire et ambigi non debeat, quin hi sint in genere parenchymatis. Multò grauissimam quaestionem atque controuersiam faciunt spinae medulla et cerebrum, quae quoniam in principibus habentur, [P42] ortus sui primordia semini vt reliqua viscera accepta referunt, debéntque annumerari inter partes similes. At ne diuersum in his genus praeter omnem omnium veterum sententiam constituendum sit, in carnis vniuersum genus coniici necesse est. Neque verò id obsistit quòd natura sint frigidior: etsi enim vt musculorum ita intestinorum nec paucorum viscerum caro omnis calida censetur, non propterea tamen vniuersum genus tale sentiendum est, cùm praeter cerebrum et spinae medullam glandulae complures, quae tum in cerebro, tum in aliis locis positae sunt, frigidae appareant. De venarum, arteriarum, intestinorum, aliarúmque partium carne, quae propria cuiusque assignari solet, alia posthac disputatio plenior adducetur. Plurima quoque huc alia se ingerunt multis implicata difficultatibus, quae tamen quoniam nondum in disputandi genus delabor, explicare hoc loco non statui, in suum quaeque ordinem posthac relaturus. Hic tamen postremò ad futuram aliquando disputationem animaduertendum duxi, non omnem spermaticam partem ilico solidam esse, vt neque carnem omnem ex sanguine [*sic*] expressam esse et effectam: sed si in partium differentiis signandae erunt repugnantiae, parti solidae mollis opponetur, quam plerique carniformem dixerunt, spermaticae sanguinea, simplici composita, similari dissimilari, informi instrumentaria, de quibus proprio loco singillatim disserteretur.

De adipe, medulla, pilis, et vnguibus. Cap. XV.

Membranae atque cuti adeps copiosus et vberior increscit: ex pingui quidem et tenaci eaque frigida sanguinis portione genitus, quae è venis excidens móxque affusa

from blood. From what blood? For surely no blood, not even maternal blood, can be added to the body of the fetus carried in the womb, except blood already prepared by the liver's activity? The kidneys and the testicles, although they seem to reproduce the nature of glands, must be admitted to this class of parenchyma, as they do not emulate glands in contributing strength to arteries and veins, but possess exceptional power, of the kind that the seed, the start of our coming into being, grants and matches to each viscus.

The substance of the spleen copies the nature of flesh more closely than the kidneys do. So does the lung substance, so that there should be no doubt or uncertainty that these are of parenchymal kind. The spinal cord and brain raise a much harder question and dispute: since they are reckoned among the leading organs, they trace back the origins provided for [P42] their development to the seed, like the other viscera, and must be reckoned among the similar parts. To avoid establishing a different kind [genus] among these, contrary to all the opinion of all the ancients, they have to be included in the whole kind of flesh. It is no obstacle that they are of a colder nature; for even if all the flesh of muscles, intestines, and quite a number of viscera is regarded as hot, yet the whole kind is not to be considered such on that account, since in addition to the brain and the spinal cord many glands lying both in the brain and in other places seem cold. Further and fuller discussion will be provided later, on the flesh of veins, arteries, intestines, and other parts, and on what is usually reckoned special about each. There is also a heap of matters here fraught with many difficulties, but since I am not yet slipping into an argumentative mood, I have not resolved to explain them here, but will take them up later in their individual order. Finally, I thought that attention should be paid at this point to an argument at some future time, that the spermatic component is not all immediately solid, any more than all flesh is extracted and created from blood. But if antipathies are to be indicated among the distinctions between parts, a soft part (which most people have called a fleshlike part) will be set against an unyielding one, one of blood origin against a spermatic one, a composite one against a simple one, a dissimilar one against a similar one, one with a function [instrumentaria] against a formless one. Each of these will be discussed separately in its proper place.

Chapter 15. Fat, marrow, hairs, and nails.

PLENTIFUL FAT grows on membrane and skin; it develops from the fatty, clinging, and cold part of blood, which emerges from the veins and then pours

frigidis exanguibúsque membranís, tanquam congelans similiter atque crassius oleum frigore durescit. Hinc corporibus quibus frigidior est natura, copiosus, calidioribus verò paucus innascitur: qui aestibus, immodicis laboribus, et in-aediis fundi atque dissipari solet. Albescit autem ex earum partium natura quibus apponitur et cohaeret. Quoniam igitur illi primum ortum confert tum sanguinis tum loci in quem inciderit natura, horum certè differentia magnam illius dissimilitudinem suscitabit: vt sit alius alio crassior sicciorque, vel tenuior atque mollior. Hos autem nominis varietas toto propè genere disiunxit, vt id quidem seuum appellare mos sit, quod crassius et magis terrenum est: adipem verò qui humidior et liquidior. Vnde cornigera (inquit Plinius) vna parte dentata et quae in pedibus talos habent, seuo pinguescunt: bisulca scissive in digitos pedibus, et non cornigera, adipe. Horum enim humidior temperatiorque natura, vti profectò et hominis cuius corpus puro synceròque adipe oblitum est atque delibutum. Neque tamen is passim sui similis, sed pro partis vi et natura dispar. Venter inferior, vt qui magna ex parte membranousus est et longè dissitus à fonte caloris, multo adipe confertus est eoque duriore ac siccior, qualis potissimùm renes ambit et obsepit. Quae sub pectore partes conditae sunt, minus adipis congesserunt eiusque mollioris: qualis circa pericardium et cordis basin videri solet. Hac propemodum lege qui circa musculos et cutem, crurum partiumque inferiorum concreuit, durior sicciorque deprehenditur, quàm qui thoracis et brachiorum musculos atque cutem perungit. At nihilominus neque frigidissimis neque siccissimis locis gaudet, quòd cuiusdam sit caloris particeps. Hinc cerebri meninges nullus circumfundit, vt rarò membranas quae ossa conuestiunt. Sic in hominum naturis qui vel calidissimi sunt, vel frigidissimi atque siccissimi, adipem nullum coaceruant, neque huic gignendo idoneam materiam habent in venis: qui verò a mediocritate in frigidum humidumque deurgunt, multò maxima illius copia redundant: et quoniam eorum sanguis totus in adipem procliuis est, non potest cordis immodicus calor illius concretionem circa pericardium, quantò minus in reliquis partibus, inhibere et arcere. Quocirca his multò promptius materiae vis abit in adipem, quàm cordis reliquarumque partium calor possit dissolvere. Qui naturae mediocritatem sunt consequuti, sanguinem media conditione obtinent: atque huius pinguior portio quaecunque in carnosas calidasque partes influet, vi caloris tota dissipabitur et euanesceat: quae verò in membranas infertur, illarum frigore ea veluti congelat. Iam de medulla. [P43] In maioribus haec ossium capacitatibus concrescens non minus consistit quàm adeps: at maximè durescit quae in spinæ fistula continetur, eoque magis quo longius à cerebro profluxerit, cuius illa ceu stipes quidam est et portio longius exporrecta. Haec

out on the cold bloodless membranes, to harden with the cold like rather thick oil freezing. So it is abundant in bodies of colder nature, but little forms in hotter ones, and it generally melts and disperses during hot weather, excessive labor, and starvation. It acquires whiteness from the nature of the parts to which it is attached. So since the nature of blood and of the place in which it has settled give it its origin, variation in these will surely create much difference in it: one fat will be thicker and drier, or thinner and softer, than another. A distinction in name has all but separated these in their whole kind: the thicker and more earthy fat is commonly called sebum; the moister and more liquid is called fat. Hence, as Pliny says, horned animals with teeth in one jaw and hooves on their feet have sebum as fat: animals with cloven hooves or feet split into toes, and without horns, have [ordinary] fat.¹²⁷ The latter have a moister and more moderate nature, undoubtedly like that of a man whose body is thickly coated with pure fat. Fat is not the same everywhere, but varies with the power and nature of the part. The lower belly, being largely membranous and far removed from the source of heat, is filled with much fat, which is harder and drier, such as encloses the kidneys particularly. The parts that are situated down in the chest have accumulated less fat, and it is softer, such as is often seen around the pericardium and the base of the heart. Approximately on this principle, the fat that has gathered around the muscles and skin of the legs and lower parts is found harder and drier than what anoints the muscles and skin of the thorax and arms. Yet it takes no delight in the coldest and driest sites, since it shares in a certain heat. Consequently none is distributed round the meninges of the brain, and only rarely any round the membranes that clothe the bones. Thus men who are by nature the hottest, or the coldest and driest, accumulate no fat, nor hold in their veins material suitable for creating any. But those who incline from a moderate state towards coldness and wetness overflow with much the greatest quantity of fat. And since all their blood tends to fat, the heart's excessive heat cannot prevent the coagulation of fat around the pericardium, much less prevent it in the remaining parts. Therefore their material power disappears into fat much more readily than the heat of the heart and remaining parts can melt it. Those who have achieved moderation of nature possess blood in a moderate condition, and all of the fatter part of it that flows into the fleshy and hot parts will be completely dispersed by the force of the heat; but the part that enters the membranes is so to speak frozen by their coldness.

Now for marrow. Condensing [P43] in the larger cavities of bones, it is present as much as fat; but the marrow in the spinal canal hardens most, and more so the further from the brain it has emanated. The marrow [spinal cord] is

quidem nullius ignis vi liquescunt aut dissipantur, quin potius soliditatem acquirunt: reliquorum ossium medulla non minus quàm adeps calore liquata dilapsaque diffunditur. Vnde intelligi potest quantum illarum inter se genera distent. Itaque quibus animantibus ossa non vt leonum vel aquilarum robustissima et solidissima esse debuerunt, maxima his interior capacitas inter-iicitur, cuius gratia cum duritie leuitatem quandam ad motum sunt conse-quuta. Non tamen inanis ea derelicta est, sed medulla multa refertur, quae ex communi ossium alimento per tenues venas eò penetrantes affluente, illic con-ditur atque reponitur, quae deinde sensim multoque tempore praeparationem accipiens albescit atque concrescit, dum sit idonea ossi nutriendo, cuiusmodi in humerorum, brachiorum, femorum atque crurum ossibus plurima comperitur. Reliqua omnia in quibus ingentes illae cauernae non insunt, seu quòd gracilia, seu quòd minus ad motum sint necessaria, in laxitatibus exilibus humorem concludunt, medulla quidem liquidiorum magisque fusum, sed qui tamen illi proportionem quadam respondet. Cerebrum et spinae medulla alium vt dixi suae substantiae modum habent. Porrò autem vngues atque pili licet in partium similarium numero non sint, consistentiam²⁸ tamen habet [*sic*; corrected to “habent” in Errata at end of the volume] et proprium vsum, vt illorum quaedam hìc ratio nobis sit ineunda. E summis digitis vngues emergunt, tanquam clausulae eorum tendonum qui ad extremos digitos desinunt. Ab his enim excrementi et eluuiei quiddam semper emanat, quod in vnguium radices con-fluens, materia fit illis perpetuò augescentibus. Lati quidem facti et modicè duri, vt summis digitis firmitas conferretur ad exiguorum corporum apprehen-sionem. Sic pilis ex crassiore et fuliginosa humorum eluuie ortus ducitur, quae per angusta cutis spiracula tanquam foras propulsa, impacta haeret in transitu, vt non sponte vacuari possit, sed alia rursum è profundo sublata hanc ferit impellítque, tum hanc rursus alia, et multo tempore coniunctae aliaeque super alias impactae, corpus quoddam reddunt et conformant angustum ex transitus angustia stipatum: quod denique à sui simili eluuie vehementer ictum foras propellitur, iam veri pili formam adeptum: huncque in modum quasi succresc-endo semper augecit. Non omnibus aequè locis prouenit, sed his maximè quibus cutis sicca calidáque plurimùm inest: frigida enim et humida huic proferendo continendóque ineptissima. Vbi sicca duráque cutis, vt in capite atque mento, prolixior rigidiorque pilus profertur, et in animantium genere iis ferè, quibus tergora densa sunt et dura, vt capris, vt suibus. Pilorum et vngium [*sic*; “vnguium” in 1542 and 1554] radices tenellae sunt et molles: quod verò ex cute extat, validum ac praedurum. In homine pili partim simul, partim postea gignuntur. Ingeniti quidem sunt in capite, sed propriè in palpebris

a sort of stem and extended part of the brain. No fire's force can liquefy or disperse these [marrows]: on the contrary, they solidify. The marrow in the other bones is liquefied and slips away with heat, just as fat does. Thus it is understandable how much the kinds of these differ from each other. So in animals that did not need the very strong and solid bones of lions or eagles, a very large internal cavity is inserted in their bones, which are thus enabled to gain, along with hardness, some lightness for movement. The cavity is not left empty, but is filled full of marrow, which is made and deposited there out of the general nutriment of bones that flows in along the fine veins that enter them. Then, being gradually made ready over a long period, it turns white and congeals, until it is fit to nourish bone, like the large amount found in the bones of the upper arms, forearms, thighs, and lower legs. All the rest of the bones lack these large recesses, either because they are thin or because they are less essential for movement, and enclose their humor in tiny spaces; it is more liquid and molten than marrow, but is its counterpart to some extent. As I mentioned, brain and spinal cord have substance of another kind.

Next, nails and hairs, though not reckoned among the similar parts,¹²⁸ exist and have a special function, and so call for some account here. The nails emerge from the tips of the digits, like terminations for the tendons that end at the fingertips. There is always some refuse originating from these, which converges on the roots of the nails and becomes the material for their continuous growth. They got wide and fairly hard, so that the ends of the digits acquired firmness for the grasping of small objects. Similarly, hair derives its origin from the thicker and sooty humoral refuse, which is forced out through the narrow vents of the skin, and gets stuck on the way so that it cannot be cleared on its own; but more arising in series from the depths impinges on it and pushes it, followed by yet more; over time they link and one is embedded on another, thus forming a body compressed to a narrow shape by the narrowness of the track. In the end, strongly pushed by the uniform refuse, it is driven outward and has now taken the shape of a true hair. This is the way it always grows, by progressive replacement. It does not grow out equally at all points, but mostly where the skin is especially dry and hot; cold wet skin is particularly unsuited to its production and support. Where the skin is dry and hard, as on the head and chin, more luxuriant and stiffer hair grows, as usually occurs too in animals with thick hard skin, such as goats and pigs.

The roots of hairs and nails are delicate and soft, but the part that protrudes from the skin is strong and very hard. In man, part of the hair is created when he is, and part later on. The head hair is inborn, but especially the hairs in the

et superciliis, quos ab ortu pari semper magnitudine natura custodit, et ne augerentur in durissimam et similem cartilagini cutem infixit. Stabiles hi quoque et erecti non ad decorem modò, sed vt vallum quoddam oculis obiecti, ne quid extrinsecus incideret, aut è capite deflueret. Qui pòst gignuntur, primùm erumpunt in pube et ano, mox in alis, postremò viris in mento, atque hi quidem vt omnes qui reliquo sunt corpore, tum ornatus, tum tegumenti gratia producti. His iam finem facio, quòd decursa et planissimè exposita iam videantur omnia, ex quibus admirabilis comparatur fabrica membrorum, solèrsque partium descriptio atque historia contextitur.

*Consectionis ratio. Cap. XVI.*²⁹

Partium corporis humani enarratio eum cursum exitúmque tenuit, qui seorsum singulas, primùm similes atque simplices, deinde compositas explanaret: sic enim existimauius omnia magis perspicua futura, si ad naturae imitationem ex simplicium aestimatione compositi cognitionem caperemus. Quisquis volet quae antè conscripta sunt dilucidè consequi, sibique in apertum et ante oculos ponere, eam quam monstro saepe viam terat, et alio cadauere musculorum, deinde ossium exiccatorum aptisque compagi-[P44] bus reuinctorum, alio viscerum interiorum consectionem instituat, alio venarum quam à iecore, alio arteriarum quam à corde inchoabit: alio denique neruorum quos à cerebro atque spina in sensus artúsque singulos studiosè diligentérque prosequatur: haec enim summa est et conducibilis inuestigandi ratio. At plerique omnes ex vno eodémque corpore omnia aut certè quamplurima sibi commostrari rogant, quorum nunc desiderio satisfacturus, quo quaeque loco, quóue ordine, qua industria (nulla earum partium quae variè implicitae sunt aut disrupta aut confusa) exhiberi possint et expromi, ad dicendum aggredior. Cadauer in primis delectum sit bona carnis habitudine, integra constantique aetate, statura mediocri et apposita, incorruptum et partibus omnibus absolutum, nec morbo, nec vulnere interemptum, verùm suspendio, stragulis, aquáue extinctum. Id praecelso editoque scamno volubili collocabitur, medio theatro perflabili, considente spectatorum corona, instructi paratíque consectores et administri, qui ad manum et in promptu habeant nouaculas, scalpella, vncos, stylos teretes, serras, terebras, malleolos, acus, funiculos, modiolos et spongas. Qui autem consectioni praeest,

eyebrows and eyelids, which nature keeps always the same size from birth, and prevents from increasing by having inserted them into very hard cartilage-like skin. They are steady and stick out, not just for appearance's sake, but as a rampart protecting the eyes to keep out anything striking them from outside or slipping down from the head.

The hairs that develop later on issue forth first in the pubes and anus, later in the armpits, finally in men in the chin, and like all those on the rest of the body, they come forth both for appearance and for protection. With them I conclude, since everything appears to have been covered and very clearly set forth that contributes to the marvelous construction of the members, and a skilled descriptive account of the parts is being put together.

Chapter 16. Conduct of the dissection.

THE ACCOUNT of the parts of the human body followed to its conclusion a course that would explain separately each of the similar and simple parts, and next each of the composite parts; we thought that in this way all would be more plain, if we followed nature in drawing our knowledge of the composite from an assessment of the simple. Let anyone who cares to follow clearly what has been written above, and to set it open before his eyes, tread often the path I indicate, and arrange in [P44] one cadaver a dissection of the muscles and then of the bones dried and linked by their appropriate bonds; in another of the internal viscera; in another of the veins (starting from the liver) and in another of the arteries (starting from the heart); in a final one let him pursue with attentive zeal each of the nerves from the brain and spine into the sense organs and limbs. This is the perfect wise plan of inquiry. But as a rule everyone requires everything, or anyway most things, to be shown to them from one single body; and to meet their need I now set about explaining how everything can be displayed in the right place and the right order, and with care to avoid disrupting or muddling any of the diversely intertwined parts.

First, a cadaver should be chosen in a good state of flesh, of established youthful age, of average and suitable height, undecayed and with all its parts, not dead from disease or wound, but killed by hanging, suffocation [literally “blankets”] or drowning [literally “water”]. It will be placed on a lofty prominent bench on wheels, amid a well-ventilated theater, with a ring of spectators seated round. Dissectors and helpers are arranged and briefed, to hold ready to hand razors, scalpels, hooks, smooth spikes, saws, drills, hammers, needles, cords, trepans¹²⁹ and sponges. The person in charge of the dissection should

enarrata principio humani corporis dignitate, qua id caeteris praestat animantibus, eoque tres in ventres et in artus distributo, omnes horum externas sedes explicet, quaeque illis veteres tum Graeci tum Latini nomina indiderunt. Haec praefatus, mox de vniuersa corporis cute deque ei subdito adipe dicere instituat. Quod dum facit iubeat inferiorem ventrem aperire atque detegere, adhibita nouacula cutem findere è medio pectoris osse ad os vsque pectinis: rursúmque per transuersum è laeuis ad dextra ilia, vt communis linearum sectio cadat in vmbilicum. Sublata dein cute, vmbilico autem intacto, gemina cutis exhibenda, epidermis densior, vera quamuis crassior rarior tamen et crebris foraminibus peruia: mox qui huic adeps obhaerebat in conspectum se dabit. Ab his musculorum abdominis explanatio facienda, quo interim spatio administri, octo musculos suo quósque ordine secernent, eas venas in rectis intactas seruantes, quae ex pube in mammas efferuntur. Post haec de peritoneo dicendum: quod tum exemptis omnibus qui in abdomine sunt musculis, consectores solum atque nudum relinquent, aut saltem id similiter atque cutem lineis duabus secabunt, extremis huius in coxas et hypochondria retortis, vt totus iam venter inferior detectus in conspectum veniat. Succedit de vmbilico brevis quaedam expositio, quae dum fiet, ministrorum erit vmbilici vasa separare et expurgare. Haec quoniam complura sunt aduersis disiecta locis, ne fortè intestinorum consecutione pereant, diiungi debent, et venae quae in iecoris caua pertinent in dextrum hypochondrium, arteriae verò et ductus qui ad fundum vesicae spectant, in pectinem vel inguen reclinare. Aperto ventre infimo, innatans omentum conspicitur: quod recitatis iis quae de eo iam conscripsimus, duplex proponatur, eiúsque ad ventriculum et colon intestinum adhaesio. Id mox eximatur, quoniam nondum eius vt neque venarum potest ortus conspici. Priusquam autem aliò res procedat, decet hoc loco intestinorum viscerúmque omnium situm speculari, vt his nondum à naturali sede dimotis, obseruare liceat quae partes quibus in cute locis, subditae sint atque respondeant; quod quidem non leue momentum ad medendi artem obtinet. Deinde verò suscepta intestinorum narratione, consectores id quod rectum appellant, eo loco vbi ad coxam sinistram eminet, locis duobus obstringent funiculis acu traiectis, medióque inter hos spatio illud execabunt, mox intestina omnia à mesenterio sensim scalpello diuellent et quasi dissuent, seruato quidem quàmmaximo licet mesenterio. Simul autem obseruare conuenit

start by recounting the status of the human body, by which it excels the other living things, and how it is divided into three bellies and into limbs; he should describe all their external points and the names the ancient Greeks and Romans gave them. After this prelude, let him start to speak next about the whole skin of the body and its underlying fat.

While doing this, let him give instructions to open and uncover the lower belly [abdominal cavity], a razor being used to divide the skin from midsternum right to the pectinate bone, and also transversely from left flank to right, so that the cuts intersect at the navel. By removing the skin but leaving the navel intact the two skin layers are to be shown: the epidermis more compact, the true skin thicker, but more loose-knit, and perforated by close-set apertures. Soon the fat that was adhering to it will come into view. Next a description of the abdominal muscles is to be given; meantime the assistants will separate each of the eight muscles in its order, preserving the veins that run in the rectus muscles from the pubes to the breasts. Afterwards the peritoneum is to be discussed; the dissectors will isolate and expose it by removing all the muscles in the abdomen, or at any rate will cut it along two lines like the skin, turning its ends back onto the hips and hypochondria so that the whole lower belly is uncovered and comes into view. There follows a short account of the navel, and during it the helpers will have the task of separating and cleaning the umbilical vessels. Since there are several of these separated on opposite sides, they should be divided to prevent their possible loss with the dissection of the intestines, and the veins related to the vault of the liver should rest on the right hypochondrium, while the arteries and the duct [urachus] that face the fundus of the bladder should rest on the pecten or groin. With the lowest belly open the omentum is seen floating on top. After the recitation of what we have already written about it, its two layers and its adherence to the stomach and colon are exhibited. Next, let it be removed, because its origin and the origin of the veins cannot yet be made out. But before things go further, it is proper at this point to observe closely the position of the intestines and all the viscera, because before they are removed from their natural position, one can note which of them underlies and corresponds to which points on the skin, a matter of considerable importance to the art of healing.

Then to return to the account of the intestines: the dissectors will tie the rectum where it bulges at the left hip, at two points with cords inserted by needle, and cut it out between these. Next they will part and, so to speak, unstitch the whole of the intestines gradually from the mesentery with a scalpel, preserving as much as possible of the mesentery. At the time it is usual to note

situs adhaesionésque singulorum compluriúmque vasorum insertiones: è quibus ne fortè praeter modum sanguis effluat, tutum erit venam quae ad portas est iecoris vincire, citra vllam aliorum perturbationem. Vt autem ad ieinum intestinum propiùs accedatur, id antequam sub venam quae ad portas est se coniiciat et recondat, duobus item vinculis excipiendum erit, medióque spatio consecandum, vt ilicò omnia intestina hinc in modiolos transportentur, in quibus demum quisquis volet possit exemptorum substantiam, figuram, tunicas, villos, reliquáque omnia nullo periculo nullóque labore contueri. Nunc autem viscera omnia denudata se produnt, quae tamen [P45] quò se apertiùs ante oculos proponant, sanguis qui in ventris capacitatem ex occulto influxit, omnis hauriendus et spongiis exorbendus est, ac in modiolos exprimendus. Explicandum deinde est mesenterium cum septem venis quae in portas³⁰ confluant: quod eo interim tempore à ministris pandetur atque extendetur, vt quae dicuntur conspicua fiant omnia. Succedit illi pancreas media inter mesenterium atque ventriculum sede. A quo deinde ventriculi sequitur narratio, quem aqua per os et gulam demissa nonnulli impleuerunt, vt suo se tumore manifestiùs promeret, naturalémque situm teneret. Quem vt omnes conspexerint, pyloron ab eius ima parte deductum, hincque ieinum per pancreas in mesaraei oras excurrans persequi decebit. Hinc omnibus in suas sedes quantum fieri potest restitutis et inuiolatis, tempestiuum erit bilis vesiculam sermone vsurpare, mox eam sublatis leniter fibris iocineris in apertum proferre, atque eum ipsius tubum quem per pancreas in ieuni intestini substantiam infigit. Sub haec verò venam quae ex portis per pancreas sub ieinum demersa in mesaraeum contendit, et eius in septem ramos enarratam distributionem nunc lucidè contueri datur, sed ramum eum maximè qui ex ingenti illo stipite in ventriculum et lienem concedit, sua comitatum arteria, quae ab aorta è diaphragmatis sedibus in iecur excedit. Si gracile et extenuatum corpus erit, singula quae dixi primo statim obtutu oculorum futura sunt obuia, sin obesius, ex trunco in primis qui ad portas est, deinde ex ramis eius singulis, adeps summo digito leniter eximendus, ne quicquam dilaceretur aut pereat. Quae vt perspecta satis fuerint, pancreas quidem intactum relinquetur: at mesenterium extirpandum et radicitus tollendum est, secta quidem vena portae sub eo loco quem vinculum obstrinxit, et adacta nouacula³¹ per mesenterij radicem, quae arteriae maiori in longum adhaeret.

the positions and attachments of each [intestine], and where the large number of vessels fit. To prevent excessive outflow of blood from them, the safe plan will be to tie the vein at the portals of the liver, without disturbing anything else. To give closer access to the jejunum, it will be best to catch it with two ligatures before it conceals itself below the portal vein, and divide it between the two, so that all the intestines can be transferred away at once into buckets, and there in the end anyone who wants can study the substance, shape, coats, filaments, and all the other details of what has been taken out, without risk and without labor. Now all the viscera protrude uncovered, but to let them present themselves more visibly, the blood that has run from its hiding place into the belly cavity should all be mopped up with sponges, and squeezed out into buckets.

[P45] Next the mesentery is to be described, with the seven veins that converge onto the porta; it will be opened and spread out meantime by the assistants, to make all that is said become clear. Behind it comes the pancreas midway between the mesentery and the stomach. The account of the stomach comes next; some people have filled it with water inserted through the mouth and esophagus, to make it bulge more obviously and occupy its natural place. When everyone has seen it, it will be appropriate to trace the pylorus leading away from its lowest part, and then the jejunum running off through the pancreas into the margins of the mesentery. Then, with everything returned undamaged into its place as far as possible, will be the moment to introduce the topic of the gallbladder, and by gently drawing aside the lobes of the liver, to expose it and the duct that it inserts via the pancreas into the substance of the jejunum.

There is now an opportunity to see clearly below the gallbladder the vein that makes its way out of the porta through the pancreas and (dipping below the jejunum) into the mesentery, with its ramification into seven branches as already described, but particularly the branch that passes from the large stem into the stomach and spleen, with its accompanying artery that emerges from the aorta and out of the region of the diaphragm into the liver. If the cadaver is thin and wasted, the details I mention will be apparent at first glance. But if it is more obese, fat should be removed gently with the fingertip from the [venous] trunk at the porta, and then from each of its branches, with care not to tear or destroy anything. When they have been examined enough, the pancreas will remain untouched; but the mesentery is to be uprooted and entirely removed, by severing the portal vein below where the ligature has blocked it, and thrusting a knife through the root of the mesentery, which clings lengthwise to

Hoc ipso autem opere speculari liceat arteriam et neruum, qui è lumbis in mesaraeum diffunditur, simulque primas omenti radices. Obseruandum hîc sedulò ne quod subiectorum vasorum, quae perampla lumbis accumbunt, aut punctum aut vulneratum diffluat. Sanguis denuò qui recens illapsus est, exhaustiendus, corpúsque omnino siccandum. Iam hoc ordine conducit iecur atque bilis folliculum, mox lienem contemplari, et omnia quae de illis sigillatim dici solent, seorsum planiùs commonstrare. Ne tamen ea labefactetur societas quae haec cum superioribus coniunguntur, nondum discindi aut eximi commodè possunt: aut si fortè id vlla ratione efficere cogemur, priùs quaecumque circumstant vasa arctiùs vincienda sunt, maximèque vena caua mox vt emersit è iecore. Post haec de renibus et vrinae viis habendus est sermo: ac tum temporis membranulas quae illic complures extant quasi exortus tum mesenterij, tum omenti, atque superiorem peritonaei membranam (id enim duplici constare proditum est) adiectumque renibus adipem, adhibitis vncis atque scalpellis consectores circumcident et amputabunt. Sic enim nuda et aperta omnia, clariora existent, arteria maior, eique assidens vena caua, nerui vtrinque per lumborum musculos propagati, et quicumque demum processus ab eorum singulis, tum in renes, tum in testes atque vesicam contendunt. Quoniam autem in hunc ordinem de renibus et viis vrinae mentio debet incidere, emulgens tum vena, tum arteria vincienda est, dextra quàm sinistra potius, quòd ab hac sinister vrinae canalis deriuetur. His tum inde dissectis vasis, ren dexter extirpabitur incideturque parte tumentiore, vt qui intus latebat sinus, iam in conspectu sit, vtque stylo terete hinc in canalis insertionem traiecto, omnis ratio exprimendae transmittendaeque vrinae cognita sit. Cum autem ad vesicam oratio transferetur, cutis ab imo ventre dextrorsum per penis radicem ad scroti extremum interscindetur, detectum nudatumque os pectinis diiungetur, obtusiore nouacula in medium cartilagosae commissurae mallei plumbei ictibus adacta, ipsisque coxis in posteriora magna vi retortis. Diductis his ipsoque pene in sinistrum inguem reducto, tota vesica propalam est, et quaecumque ei astant particulae. SpermatICA vasa atque testes iam explicare decet, partèque sinistra quam integram reseruauimus, idipsum vas ab emulgente per medias peritonaei membranas persequi adusque coxam sinistram. Inde testis sinister abripietur à scroto, penitusque diducetur, quòd manifestiùs patefiant quae in eo sunt omnia. Quin et

the aorta. In the course of this task one may watch for the artery and the nerve that disperses from the loins into the mesentery, and at the same time the original roots of the omentum. Care must be taken here that none of the underlying vessels that rest distended on the loins gets punctured or wounded and leaks. Blood that has newly oozed in is to be removed again, and the body dried out. In the present sequence it helps to view the liver and gallbladder, then the spleen, and demonstrate separately more clearly all the separate points usually made. In case their relation to higher parts should be upset, they cannot yet conveniently be divided or taken out; or, if we are compelled to do so for any reason, all the surrounding vessels must be tightly tied, particularly the vena cava close to where it left the liver. After this should come discussion of the kidneys and urinary channels; at that time the numerous membranes there that form origins for the mesentery and omentum, the upper peritoneal membrane (its double pattern was mentioned), and the fat attached to the kidneys will be cut around and removed by the assistants with hooks and scalpels. Uncovered to view like this, everything will stand out more clearly: the aorta, the vena cava beside it, the nerves extending on each side through the lumbar muscles, and lastly all the branches from each of them making for the kidneys, testicles and bladder. And since reference to the kidneys and urinary channels should be included in this sequence, an emulgent artery and vein should be tied, the right rather than the left, since the left urinary channel¹³⁰ originates from the latter. Then, when these vessels have been severed, the right kidney will be extracted and incised on the more protuberant part, to bring into view the cavity that was lurking within, and so that by passing a smooth probe from it into the channel's entrance [into the ureter], the whole pattern for squeezing the urine out and passing it along is grasped.

When the discourse moves to the bladder, the skin will be slit from the bottom of the belly back through the root of the penis to the end of the scrotum, and the pectinate bone will be exposed to view and separated, by driving a rather blunt knife into the middle of the cartilaginous commissure with blows from a lead hammer, and forcing the hipbones back with considerable strength. When they have been pulled apart and the penis withdrawn onto the left groin, the whole bladder and the adjoining parts are exposed. Now is the time to describe the spermatic vessels and testicles, and on the left side, which we left intact, to trace that particular vessel [the left testicular vein] from the emulgent [renal vein] through the middle of the peritoneal membranes right to the left hip. Next the left testicle will be pulled out of the scrotum and drawn completely aside, so that all its contents become more visible. Also the

parastates indicandus est intrò ad vesicae ceruicem recurrere, et in penis canalem confluere, omnia denique quae plenius suis locis à nobis sunt prodita. Haec demum vt eximantur vinciendae se-[P46] secandaeque sunt emulgentes, tollendique renes, item ductus vrinae, vasa spermatica, testes, genitale ac vesica, vena tamen caua et aorta quantum maximè fieri potest illaesis. Si alicunde sanguis largiter affluet, aut constringendus continuò locus erit, aut consuendus, quantúmque sanguinis circumfluet spongiis combibendus. Porrò autem si fortè mulier consecatur, quaecunque de vtero dici debuerunt, modicè sublata duntaxat vesica, hic apertè commonstrabuntur, situs, cornua, testes, canalium insertio, ceruix, ostium geminum, omnium denique venarum quae ad hunc vtrinque feruntur infixio. Vterum autem vt vnà cum caeteris ministri abstulerint, solùm restabit intestinum rectum, in cuius haemorrhoidas è ramis venae cauae deriuatas, animum sensúsque intendere conueniet. Hoc tandem eiecto nihil in ventre inferiore praeter venas et arterias reliquum erit. Quocirca his duntaxat manentibus velim deinceps ad vitales partes transiri: in quas dum incumbunt consectores, eorum administri crura interim deglubent ac nudabunt, vt quae in haec permeant venarum, arteriarum, neruorúmque propagines ac musculi, suo quaeque loco et ordine clariùs in conspectu et oculis sint omnium, in quibus administrandis non alium cursum teneri velim, quàm qui de illis suprà est à nobis conscriptus. In thorace igitur primùm cutis detrahenda, sub qua musculi, mammarum glandulae, subditaque costae enarrari commonstrarique debent. Hinc capacitas interior adeunda, ducto scalpello ex punico malo per os medium pectoris in summum iugulum, vt costis deinde in contraria versis ac retortis, dissepientes membranae (quas diximum geminas haberi) diuelli, et in suum quaeque latus distrahi possit. Id autem si factu operosum nimis et fallax lubricúmque videatur, altera dissecandi consuetudo inueterauit, quae discissis vtrinque extremitatibus costarum cartilaginosi, os vniuersum pectoris tollit: quod tamen dum fit cautio adiungenda est, ne vena caua quae ad iugulum est vulneretur: simul verò nerui proponentur, qui firma adhaesione ossis interiora peruadunt. Hinc dissepientem membranam stylus alter in longum, alter in transuersum actus, alioqui lapsuram excipiet atque continebit. Quibus ita rectè constitutis, omnia quaecunque thoracis capacitas includit recenseri apertèque depromi poterunt. Primùm quidem diaphragma è costarum extremis natum, iisque suprà subtérque annexum: deinde

prostate¹³¹ is to be demonstrated, running inward to the bladder neck and draining into the penile channel, and to conclude with, everything that we have covered more fully in its own place.

To get these parts out, [P46] the emulgents are to be tied and cut, and the kidneys removed, as also the urinary channels, spermatic vessels, testicles, genitalia, and bladder, but keeping the vena cava and aorta intact as far as possible. If a lot of blood runs in from anywhere, either the place will need immediate compression, or stitching, and all the inflow of blood will need sponging out. Also, if a woman is the subject, everything about the womb that needed description will be shown to view here: position, horns, testicles [ovaries], the entry of the channels, the cervix, the twin orifice,¹³² and finally the insertion of all the veins that run to it on each side.

When the assistants have removed the uterus along with the rest, all that will remain will be the rectum, where the hemorrhoids that stem from branches of the vena cava should be seen and noted. When it has been extracted, only veins and arteries will be left in the lower belly. So, with just these remaining, I would like to turn next to the vital parts [i.e., heart, lungs, etc.]; while the dissectors devote themselves to these, the assistants will meantime flay and expose the legs, so that the venous, arterial, and nerve branches and the muscles that make their way into them are more clearly visible to everyone, each in its proper place and arrangement. In carrying this out I would like the same sequence to be followed in which I described them above. So in the thorax, first the skin is to be removed, and under it the muscles, mammary glands and underlying ribs are to be described and demonstrated. Next the interior cavity is to be approached, by drawing a scalpel from the xiphoid process through the middle of the sternum into the top of the breastbone,¹³³ so that next the ribs can be turned and bent back apart, the mediastinal membranes (we said they were double) parted, and each pulled away to its own side. If this seems too hard to do and precarious, a different dissecting procedure has established itself, which cuts through the ends of the costal cartilages on each side and removes the whole sternum. But during this care should be taken not to wound the vena cava at the region of the top of the breastbone. At this time nerves are exposed that traverse the interior of the bone and stick firmly to it. At this stage a probe inserted lengthwise and another transversely will support and restrain the mediastinum, which otherwise would collapse.

When these arrangements have been completed, it will be possible to review and display all the contents of the thoracic cavity. First, the diaphragm, originating from the rib ends and attached to them above and below; then the

verò membranarum tum costas succingentium, tum intersepientium adhaesio mutuâque societas. Quibus apertis pulmones describere contemplarique expedit, vt ij cor amplexentur, omnémque capacitatem impleant: quos tamen qui volet ori folle addito, aëre spiritúque distendere, is praeter situm eos quoque motus studiosè comprehendet, qui in viuientibus nobis obeuntur. Ab his pericardium suprà aperietur, obseruato humore quem concipit. Mox suscepta cordis tractatione, situs eius omiúmque [*sic*; “omniúmque” in 1542 and 1554] canalium qui tum in id inseruntur, tum ex eo spectant in pulmones, obseruandi. Quanquam autem qui operi explanando praeficitur, hic quadam orationis continuatione cordis ventriculos et valuulas, horúmque substantiam atque magnitudinem fortè expediuit, nondum tamen cor incídi debet, neque caeterorum quicquam quae tum illic, tum sub diaphragmate posita sunt diuellendum, ne vno quouis rupto aut lacerato, germana naturalísque constitutio vnà pereat. Quocirca istorum vt aliorum complurium plenior commonstratio in posterum differetur. Nunc verò vtilis se offert venae cauae speculatio, quam minister dextrum pulmonem manu molliter extollens, indicabit è iecoris conuexo per diaphragma sursum commeare, hácque parte dextra ad iugulum festinare, processúque propagines in diaphragma et pericardium edere, ramo cordis ambitum irrigare, pariete suo sinistro illius dextrum ventriculum subire atque circumplecti: paulóque suprà, venam coniugij expertem in quintam dorsi vertebram deiicere, quae mox deorsum excurrens multis riuulis octo vtrinque costas inferiores alit. Omnibus hanc ipsam constitutionem seruantibus, commodum est de neruis è sexta cerebri coniugatione huc missis verba facere: de hísque rursum qui è dorsi medulla in singula costarum interualla vtrinque porriguntur. Hi enim nunc conspicuò discerni poterunt, vt et ij sanè qui per costarum radices vtrinque ad inferiora contendunt, et qui per dissepientem membranam in medium diaphragma se inferunt, et qui per sterni concaua in diaphragmatis summa apud malum punicum figebantur. Qui autem vnà cum oesophago ventriculum subeunt, posthac apertiùs eminebunt. Iam pars aduersa adeunda est, [P47] sinistérque pulmo similiter erigendus, vt simulatque arteriarum è corde distributio recitabitur, maioris illius trunci deiectio in spinam, eiúsque in duos insignes ramos sursum deorsúmque latos diremptus spectetur. Quae omnia quò cunctis clariora euadant, interim dum arteriarum atque venarum productiones memorabuntur, iugulum atque guttur detegendum

attachment and mutual relation of the membranes that line the ribs and those of the mediastinum. When these are laid open is the time to describe and study the lungs, how they embrace the heart and occupy the whole cavity. Anyone who cares to apply bellows to the mouth can inflate them with air and spirit, and besides their position will appreciate with interest the movements carried out in us during life. After them the pericardium will be laid open in front, noting the humor it contains. Then by dragging on the heart, its position and that of all the channels which are attached into it and face out from it to the lungs are to be viewed. Although the person in charge of the exposition has perhaps extended his discourse somewhat here to cover the heart's ventricles and valves, and their substance and size, nevertheless the heart should not be incised yet, nor should anything else located there or under the diaphragm be torn apart, in case with any single rupture or rent the natural arrangement is destroyed. For this reason fuller demonstration of these and a number of other matters will be postponed.

Now there is a useful opportunity to view the vena cava; an assistant, gently lifting up the right lung with his hand, will show it passing up from the vault of the liver through the diaphragm, and there on the right side speeding to the region of the top of the breastbone, giving off branches to the diaphragm and pericardium as it goes, moistening the circumference of the heart with a branch, and with its left wall winding round behind the right cardiac ventricle. A little higher up, it sends back the unpaired vein [azygos vein] onto the fifth dorsal vertebra, which goes on to run down and nourish with numerous streams the eight lower ribs on each side. Since everything follows this particular pattern, it is convenient to mention the nerves from the sixth cerebral pair that are sent here, and also those that extend from the dorsal spinal cord into each intercostal space on each side. The latter can now be clearly seen, as well as those that travel through the roots of the ribs on each side towards the lower parts, and those that enter the middle of the diaphragm through the mediastinum, and those that were inserted via the hollow of the sternum into the top of the diaphragm at the xiphoid process. Those that meet the stomach along with the esophagus will show up more clearly later.

Now the opposite side is to be approached, and the [P47] left lung raised up in the same way, so that during the discourse on the distribution of arteries from the heart, the descent of that large [aortic] trunk onto the spine can be viewed, and its division into two notable branches heading up and down. To make all this clearer to the whole audience, while the arterial and venous branches are mentioned, the region of the top of the breastbone and the throat should be

adusque oris interiora, findendâque est maxilla inferior, adacto cultro in eam menti commissuram multò arctissimam atque contumacissimam, quae primores inter dentes consedit. Quod si non facilè praestari potest, maxilla infirmiore loco obteri debet, aut serra desecari. Cùm autem sic nuda et in medio posita erunt omnia, tum venae cauae, tum arteriae diductio omnis quae apud ganglium in alas, in humeros, in ipsam denique cervicem sit, clarius elucebit. Quòd si illarum productiones in extremum animo est promouere, decet administratos per otium eas in brachiis consequutione quadam retegere: at priùs tamen cautione quadam vinculis excipiendi sunt rami omnes, statim vt è stipitibus suis emergerunt. Nerui recurrentes hunc iam ordinem tenent, vtrinque ab arteriarum ramis quos circumplicant, ad laryngem sursum perspicuè reducti. Post hos sunt guttur, larynx, epiglottis, tonsillae, lingua, et quicumque huc nerui pertinent atque venae: deinde columella, palatum et dentes, quorum non minus perspicua est inspectio, quàm expedita atque brevis explicatio. His ita permixtè vniuersèque citra vllam disruptionem aut ademptionem commonstratis, expedit demum singula solerter eximere, simùlque illa denuò seorsum rimari, quò prorsus et vsquequaque perspicua sint et tanquam in clarissima luce exposita. In primis itaque et vena caua et aorta sub ganglio excabatur, priùs tamen vinctis vt dixi ramis omnibus qui illinc sparguntur, maximè verò iis qui in cervicem et caput excedunt. Vena caua ea rursum sede quae inter diaphragma et cor posita est, ipsa quoque aorta arteria in trunco maiore statim vt ex corde emergit in spinam, discindetur adhibitis priùs vtrinque vinculis. Summa lingua, asperâque arteria tum demum ab oesophago sensim detrahetur, infixâ nouacula ad dissepiens membranae radicem, tota dirimetur adusque diaphragmatis concursum, deinde verò arrepta sublatâque lingua et aspera arteria, mox pulmones insequentur, itémque dissepiens membrana, pericardium, cor, et quaecunque vasa in id pertinere diximus: restabunt duntaxat oesophagus et ramus aortae qui spinae dorsi accumbit. Horum iam extirpatorum debet accuratiùs substantia percipi: itémque figura, magnitudo, partiùmque numerus, quammaximè autem ventriculorum cordis, valuularum et vasorum in pulmonibus constitutio, quae dum reliqua administrabuntur, ingenti lebetè ebulliri poterunt proximo spectantium conuentu minutatim excutienda et explicanda. Vt autem quae reliqua sunt viscera eximantur integriùs, vena caua eo loco qui inter iecur et renes medius interponitur discindenda: tum deinde oesophagus

uncovered as far as the inside of the mouth, and the lower jaw should be split, by applying the knife to the chin commissure, much the closest and most resistant,¹³⁴ which lies between the front teeth. If this cannot be easily achieved, the jaw should be crushed in a weaker place, or sawn across.

When everything is set out uncovered in the open like this, the whole distribution of both vena cava and aorta at the ganglion¹³⁵ to the armpits, arms, and finally to the neck will become clearly visible. But if the intention is to display their extensions to the limit, it is best for the assistants to display them in the arms without hurry, in an orderly sequence. But first, all the branches should be caught carefully in ligatures, right where they leave the trunks. The recurrent nerves now take the following course: from the arterial branches on each side around which they wind, they are led back up to the larynx. After them are the throat, larynx, epiglottis, tonsils, tongue, and all the nerves and veins that belong here; then the columella [uvula], palate, and teeth—as easily visible as their description [can be] rapid and concise.

When these parts have been described in various combinations and all together, without disrupting or removing any, it is proper to remove items skillfully, and while doing so to scrutinize them again separately, in order to make everything totally visible in every way and exposed in the clearest fashion. To start with, the vena cava and aorta will be cut out below the ganglion, after tying (as I mentioned) all the branches that ramify from them, particularly those that run off into the neck and head. The vena cava, lying at the back between the diaphragm and heart, and the aorta at its large trunk just where it leaves the heart for the spine, will be cut after being tied on each side. The top of the tongue, and after it the trachea, will be pulled gradually off the esophagus. A knife will be inserted at the root of the mediastinum, which will be all cut through up to the junction with the diaphragm. Then the tongue and trachea are grasped and pulled up; the lungs follow next, and then the mediastinum, pericardium, the heart, and the vasculature that we said was associated with it. There will remain behind just the esophagus and the branch of the aorta that lies on the dorsal spine. The substance of what has been removed should now be noticed more precisely, and similarly their shape, size, and number of parts, but especially the arrangement of the ventricles of the heart, of the valves and of the vessels in the lungs. While the rest is being dealt with, these can be boiled up in a large vessel close to the gathered spectators, to be spread out and disentangled in detail.

To let the rest of the viscera be removed fairly intact, the vena cava is to be transected between the liver and the kidneys. After that, the esophagus will be

subdito scalpello vnà cum adhaerentibus ei neruis, qui tum manifestissimè se promunt, secernetur, móxque nouacula per diaphragmatis radicem acta, id primùm, deinde ventriculi, iocineris, atque lienis vincula circuncidet. Apprehensa tum gula, multa protinus consequuntur, nempe ventriculus, ieiunum intestinum, iecur, lienis, et venae portae atque cauae non exigua portio. Hoc autem ipso opere decet animum ad arterias adhibere, et ad neruos qui ex spinae compluribus locis in haec viscera proferuntur. In singulis cùm exempta fuerint, licet substantiam, figuram, magnitudinem, partiúmque numerum seorsum ad vnguem explorare atque sagaciter inquirere: at situs et connexio non nisi cùm omnia haerent in corpore, nondum de suis deuulsa sedibus, certò perspici possunt. Iam verò extis omnibus sublatis, aorta spinae accumbere adusque renes sola conspicitur, in qua complura cernere est earum arteriarum foramina, quas in diaphragma, ventriculum, iecur, lienem, mesenterium, atque renes efferri diximus, omnia quidem inter se finitima eo situ vbi initium est lumborum. Locus sanè et occasio híc pulchrè offertur ad venarum arteriarúmque in omnes artus distributarum consectionem, hanc tamen non alia via atque ratione administrandam statuo, quàm quae suprà est a nobis exposita. Quocirca de capite praeciendum iam est. Post eius capillos atque cutem, plerique solent caluae ossa, omnésque suturas edisserere, quod dum fit calua tota serrae crebris impulsionibus circumciditur, móxque sensim extirpatur, vt qui è me-[P48] ningibus per suturas in pericranion emanant villi spectentur. Dehinc autem inito sermone de meningibus, crassior illa vncis sublata, ex fronte in occiput desecabitur, in qua quò turgidiores et illustriores conspiciantur venae, ceruicis venae et arteriae conseruentur arctioribus vinculis obstrictae. Sub hac tenuis altera meninx similiter vncis extollenda palámque indicanda: hinc proximum erit ostendere vt ambae inter priores cerebri partes iunctae demergantur, vtque cerebrum à cerebello copulatae disterminent. Ab his autem cùm cerebri completa erit descriptio, pars eius summa ad dimidium ferè minutatim resecabitur, dum detracta superiore illa medullae portione, priores intus ventriculi, quíque in eis contextus est choroides, patefiant: dúmque sensim ablato eo quasi fornice qui ventriculum medium integit, canalis vermi similis ab hoc in cerebellum traiectus, animaduerti possit oculisque lustrari cum glutiiis vtrinque assidentibus. Priusquam hinc vltrà pergatur, septem neruorum coniugationes explicari demonstraríque sigillatim debent, cerebri quidem lateribus molliter alternè sublatis: hae siquidem diu incorruptae

separated by putting a knife underneath, along with the nerves sticking to it, which are extremely prominent at this time. Then a razor pushed through the root of the diaphragm will cut around it, and then around the ligaments of the stomach, liver, and spleen. Then by grasping the esophagus, many organs follow it out directly: the stomach, jejunum, liver, spleen, and a good deal of the portal vein and vena cava. During this procedure it is a good plan to pay attention to the arteries, and to the nerves that run out from numerous places in the spine into these viscera. When they have been removed in each case, their substance, shape, size, and number of parts can be examined with keen precision. But their position and links can only be reliably made out while they are all still in the body, not yet wrenched from their places. Now that all the entrails are out, the aorta is seen on its own resting on the spine as far as the kidneys, and a number of holes are seen in it for the arteries that we mentioned running out to the diaphragm, stomach, liver, spleen, mesentery, and kidneys, all close together at the point where the loins start. There is a splendid opportunity here to dissect out the arteries and veins distributed to all the limbs, but I am determined that this must only be done in the fashion explained above.

It is now time to give instruction about the head. After its hair and skin, most people usually deal with the bones of the skullcap and all its sutures, and meantime the whole skullcap is cut around by repeated saw strokes, then gradually removed, so that the filaments that proceed out from the [P48] meninges through the sutures into the pericranium are seen. Next, once the discourse on the meninges is begun, the dura will be raised up on hooks and cut away from the forehead to the occiput. To make its veins swell more strikingly, the ligatures on the neck veins and arteries should be kept quite tight. Below it the second meninx, the thin one, should be raised likewise on hooks and shown to the audience. The next task is to show how both meninges link and dip down between the front parts of the brain, and how they join to separate cerebrum from cerebellum.

When the description of the cerebrum has thus been completed, practically half of its top will be cut away little by little, until pulling away the upper part of the medulla¹³⁶ brings the anterior ventricles inside into view, along with the choroid tissue in them. And during gradual removal of the archlike structure [fornix] that roofs the middle ventricle, a channel like a worm¹³⁷ crossing from there into the cerebellum can be noted and scanned, with the “buttocks” [corpora quadrigemina] adjoining it on each side. Before going further, seven pairs of nerves ought to be disentangled and demonstrated individually, by gently lifting the sides of the brain alternately, provided these nerves remain still

manent. At contextus admirabilis vt et certè vermis atque glutia, tridui quatruiduue cadaueribus praesertimque strangulatis flaccescunt atque contabescunt, vix vt ea clarè detur internoscere. Recens autem extincto animante contextum illum choroidem è prioribus ventriculis persequi conueniet adusque lacunam et cerebri basin, è qua vt crassa meninx euulsa fuerit, glandula in conspectum veniet, sub qua et osse praetenui quod veluti summa est cunei facies, contextus ille mirabilis integer pleniùsque cernetur. Postremò autem cerebello detecto ventriculus obseruabitur, illiùsque in spinae medullam deriuatio: itémque venarum et arteriarum extrema illuc ex inferis partibus allata. Quòd si praeterea spinam omnem in longum diffindere placet, erunt perspicui sanè omnes prodeuntium illinc neruorum exortus, quos qui volet cum musculis consequutione quadam ad extremum persequi, destinatum in id corpus consecabit, eum prorsus ordinem imitatus, quem suprà de neruis ac musculis conscripsi. Sensuum speculari instrumenta nullius est laboris aut industriae, quin et omnis oculorum compositio non minus ex bubulis quàm ex humanis animaduerti potest. Quocirca hìc iam rei finem pono, cùm summa et generalis ratio administrandae consectionis satis supérque explicata videatur: nam singula quae vnusquisque nullis adminiculis, sed vt dicitur suo marte minimáque meditatione suffecerit, hìc frustrà viderer persequutus.

Peroratio

Firmissima artis medicae fundamenta iactauimus, dum descripta humani corporis consectione, omnes eius particulas singillatim ob oculos proposuimus: quarum cognitio si sensuum fide atque constantia firmabitur, vim quodammodo iam adipiscitur aut communium euidentiùmque notionum, aut earum quas Geometrae non demonstrare, sed postulare solent vt sibi concedantur, ex quibus posthac aditus ad demonstrationem facilis patebit. Si praeterea fructus commoditásque spectabitur, consectio eam subiectam materiam explicat, in qua omnia quaecunque ars praecipit versari examinarique debent. Vt enim qui rerum gestarum memoriam repetunt, non illas rectè possunt animo concipere, nisi priùs locos et regiones quibus obtigerunt vel sensibus lustrarint, vel sibi quodammodo ipsi cogitatione depinxerint: sic profectò si quaecunque solet ars medendi tractare percipienda sunt, necesse est humanum corpus perspectum habere, in quo omnia contemplemur et quasi penitus animo cernamus. Huc atque illuc errans et vaga est omnis rerum cognitio,

undecayed. However, in third- or fourth-day cadavers, especially if strangled, the rete mirabile, and certainly the “worm” and the “buttocks,” go limp and decay, so that they can hardly be made out clearly. It will be suitable to use a freshly killed animal for tracing this choroid tissue from the anterior ventricles up to the lacuna¹³⁸ and the foundation on which the brain lies [i.e., not the “base of the brain”]. When the dura mater is torn from this, a gland [pituitary] will come into view; under it and below the very thin bone that is the top surface of the sphenoid, the whole of the well-known rete mirabile will be fully visible. Finally, by uncovering the cerebellum a ventricle [the fourth] will be noted and its extension into the spinal cord, together with the endings of arteries and veins coming up here from below. If you decide to go further and split the whole spine lengthwise, the origins of all the nerves proceeding out from there will certainly be obvious; anyone who wants to trace them and their muscles in sequence to the end will dissect a body chosen for the purpose, following entirely the order I described above for nerves and muscles. Examining the sense organs is a task needing no hard work or diligence; besides, the whole structure of the eyes can be studied just as well in oxen as in men. So I bring the matter to a close here, since I think the complete general method for arranging a dissection has been explained exhaustively; I think I would be wasting time going through details here that anyone will manage on his own, without instruments and with minimal practice.

Peroration.

WE HAVE laid down the strongest foundations for the art of medicine, by having described the dissection of the human body and brought all its parts one by one into view. If acquaintance with them is reinforced by reliable evidence from the senses, it somehow acquires power: either the power of general and manifest notions, or the power of those that geometers do not usually prove, but demand to be granted to them; from these an easy access to proof will emerge later on. In addition, if benefit and usefulness are the aim, dissection sets out the subject material in which all that art teaches should be pondered and weighed up. Those who go over the record of past events cannot grasp them properly in their mind unless they have either scanned the relevant sites with their senses, or somehow represented them to themselves in thought. In the same way, if the usual business of the art of healing is to be grasped, we must keep the human body in view, in which we ponder and mentally recognize everything thoroughly. All knowledge of things strays hither and thither, and is

futiles parúmque stabiles memoriae, quae in hoc tanquam solio non consistunt atque sustinentur. Res quidem quàm verba multò sunt constantiores, et quibuscunque vel morbo, vel aetate ingraescente, vel diuturnitate temporis mentis sensa vaneunt, iis priùs nominum quàm rerum cognitio atque memoria deponitur. Vnde cùm tanta in rebus et in locis vis insit admonitionis, non sine causa ex his veteres cognitionis et memoriae duxerunt disciplinam. Itaque vt ad historiae fidem Geographia, sic ad rem medicam corporis humani descriptio pernosceda.

not a throne in which memory, fickle and inconstant, settles and gains support. Things are much more dependable than words; those people in whom disease or advancing years or the passage of time have deleted the sensations of the mind lose the knowledge and recollection of names first, and of things later. Hence, since things and places possess such power for recall, it was with good reason that the ancients used them to train knowledge and memory. And so, as geography should be learned well to give credibility to history, the description of the human body should be learned well in the cause of medicine.



DE ELEMENTIS. LIB. II.

Praefatio.

[P49] QUI PARCÈ ac leuiter in philosophia artium omnium procreatrice versati, medendi artem discendam tradendámve suscipiunt, satis supérque se facturos existimant, si humani corporis anatome decursa, è vestigio ad singulorum morborum cognitionem curationémque festinent. Hoc dum illi compendio sibi viam parant, moliuntúrque breuem ac facilem artem, in perpetuae obscuritatis latebram praecipites se deuoluunt, et quasi luce menti [*sic*] erepta, densam noctem ac tenebras ob oculos offundunt. Est enim ipsa ratio lux mentis, quam qui despuunt, neque rerum causas intueri, neque quid quaque in re uerum [*sic*; initial U, not V; 1542 has V] exquirere, neque falsa diiudicare possunt: sed omni aeuo singulari illo splendore destituti, caeco quodam et temerario nixu sursum deorsum trahuntur: dissolutam et sine neruis ac articulis huc et illuc fluctuantem futilémque rerum confusionem animo consequuti, cunctis in rebus quasi modò nascentes obhaesitant, nihil ratum, nihil comprehensum, nihil fixum habentes, sed semper in ancipiti et eo loco stantes, à quo leui momento possint dimoueri. At verò qui admirabili quodam philosophandi studio concitati, conabuntur in ea curricula venire, in quibus celebrium virorum impressa sunt vestigia, ij rerum cognitione primùm accepta quae sensibus obuiam inciderunt, rudi earum contemplatione, minimum tenebuntur, sed vltrà progressi mentis agitatione eò se conferent, vnde tanquam praegressis ex causis illae suam originem traxisse videantur. Hinc sensim penetrabunt altiùs, donec id tandem cogitatione pertingant, in quo expleta mens tanquam in extremo consistat. Quum igitur humanum corpus anatome in partes sensu conspicuas dissolutum iam sit, ab his deinceps ad ea transeundum, quae cogitatione sola discuntur, et altiùs inuestigandum ex quibus elementis pars vnaquaeque condita sit, et quae sit elementorum permistio, quae temperatio, quae vires ac facultates lateant in illis, et quo spiritu quòve calore seruentur. Quum analysi haec inuenta perceptaque fuerint,



BOOK 2

THE ELEMENTS

Introduction

[P49] THOSE WHO have dabbled in philosophy, the mother of all the arts, and then take up the study and handing down of medicine, think they will be doing more than enough if they rush through human anatomy and hasten forthwith to the recognition and treatment of individual diseases. By setting out along this shortcut, and striving towards a shallow and easy art, they topple down headlong to lurk in eternal gloom, and throwing away the light from their mind, they pull thick darkness over their eyes. For it is reason that is the light of the mind, and those who spurn reason cannot contemplate the causes of things, nor sort out what is true in each context, nor distinguish falsehood. Deprived forever of that remarkable brightness, they are dragged up and down by blind ill-considered straining. They have acquired a mental confusion that is easygoing and sways pointlessly to and fro, without nerves and joints; they keep faltering over everything as if only just being born, thinking nothing is decided, grasped or firm, but always wavering, and capable of displacement from their stance by a slight push. On the other hand, those who are spurred on by an admirable zeal for philosophy will seek to follow where the footsteps of notable men lead them. Starting by accepting the knowledge of things that have impinged on their senses, they will spend little time in mere contemplation of them, but will advance further in mental activity and apply themselves to the question: from what as preceding causes do these things appear to have derived their origin? From here they will gradually enter more deeply in, until finally they reach the point in thought where the mind is full to the limit and comes to rest. So, since the human body is already divided up by anatomy into the parts open to sense, the next stage must be to move across to these that are learnt by thought alone, and to track down further the elements that contribute to each part, and their elemental mixture, their temperament, the powers and faculties that lie hidden in them, and the spirit and heat by which they are maintained. When these matters have been discovered and grasped by analysis, then it will

compositionis dein ordine conspicuum fiet, quae sint effectrices omnium causae, qui ab his gignantur humores, quae partium singularum functiones sint, et quae naturalis omnium administratio. Sic vniuersa contrahetur physiologia, quae naturalem de homine contemplationem demonstrationis vi constituit.

*Humani corporis in partes tum compositas, tum simplices
dissolutio. Cap. I.*

HUMANUM CORPUS vnum efficit tum continuatio seriésque partium, tum omnium consentiens et in molitionem vnam conspirans illa cognatio. Id autem simplex cùm minimè sit, varium efficitur partium diuersi generis structura, et earum multiplici figura: quae non modò locis disclusae iacent, sed etiam aliae ex aliis sunt conditae, aliisque aliae figuris insignes, prout sua cuiusque conditio et facultas poscere videbatur. Itaque corpus vniuersum, in caput, thoracem, ventrem et artus dirimi distrahíve potest, ex quibus coagmentatum apparet, haec ipsa rursum in alia: caput quidem in faciem, oculos, frontem, nasum, auriculas, aliáque plura: thorax in pectus, latera et pulmones: venter in abdomem [*sic*; 1542 has “abdomē”], subditáque viscera: artus in tota crura et brachia: atque haec in humeros, cubitos et manus. Rursum verò haec singula minutiùs conciduntur, vt manus in digitos et palmam, digiti in alia, vt in cutem, venas, arterias, carnem, neruos, tendones, vincula, cartilaginem, membranas et ossa. similiter [*sic*; “S” in 1542] caetera membra qui penitus introspiciet, [P50] sentiet vnumquodque in haec omnia vel certè plurima dissolui, vltra quae iam nihil vel diligentissima sensuum observatio possit cognoscere. Sui enim haec vndique similia sunt, vnam parilémque omnino substantiam adepta: vnde primùm Aristoteli ὁμοιομερῆ, id est eiusdem naturae partes nuncupantur, quae simplices quoque dici possunt, in quibus nimirum tanquam sensu minimis corporis dissolutio consistit. Sic quidem vltimae sunt et extremae, quae tamen si compositio spectabitur, primae fient omnium. Ex harum enim compactione aliae partes constant, quas ἀνοιομερεῖς, id est naturae dissimilis appellant, vt plerique simplici nomine illas similes, has verò dissimiles. Illas praeterea primas et simplices, has compositas, quòd illae istarum gratia habentur, et tanquam materia quaedam in dissimilarium compage et coagmentatione substernuntur. In compositis modus statuitur, vt hae

become clear from the sequence of their composition what the efficient causes of everything are, what humors are generated by them, what the functions of individual parts are, and what the natural management of everything is. In this way a comprehensive physiology will be put together, that establishes the natural study of man by the force of demonstration.

Chapter 1. Resolving the human body into composite parts and simple parts.

A HUMAN body is brought into existence both by an unbroken sequence of parts, and by the well-known harmonious affinity of everything, combining in a single effort. Being far from simple, a body is made diverse by construction from parts of varied nature, and by their manifold shape. The parts not only occupy separate positions, but some of them are made up out of others, and some are distinguished from others by their shapes, according as the character and faculty of each appeared to require. Thus the whole body can be divided into head, chest, belly, and limbs, from which it is evidently assembled, and these [components] can be divided again into others: the head into face, eyes, forehead, nose, ears, and a number of others; the thorax into chest, sides, and lungs; belly into abdomen and underlying viscera; limbs into whole legs and arms; and these into upper arms, elbows, and hands. These items are again divided more finely: for instance, hands into fingers and palm, fingers into other components, such as skin, veins, arteries, flesh, nerves, tendons, ligaments, cartilage, membranes, and bones. Similarly, anyone who looks deeply into the other members will [P50] discern that each is resolved into all these or at any rate very many, and beyond them nothing is then discoverable even by the most searching scrutiny by the senses. For these parts are in all respects like themselves, possessing a single entirely equal nature; hence they are first named by Aristotle Homoeomerous, that is, parts of the same nature, and they can also be called Simple, in which presumably, as the smallest [components] perceptible to sense, the resolution of the body takes place. Thus they are the last and final components, but if assembly is being considered, they will become the first of all.

By fitting them together other parts are formed, which they call Anhomoeomerous, that is, of dissimilar nature, and thus many people call the former by the simple name “similar” and the latter “dissimilar.” Again, the former “first and simple,” the latter “composite,” because the former are reckoned to be for the purpose of the latter, and are a kind of underlying material in the assembly of the dissimilar ones. There is a scale of complexity, so that some

minus hae verò magis compositae iudicentur. Est autem et cùm discernendo partium gestiones et munera spectantur, atque tum quoniam officiorum actionúmque gratia, corporis partes conditae sunt, omnem eam partem cuius opera communem toti corpori actionem edere possumus, instrumentum licet appellare, et quasi subsidium ad aliquid agendum. Deinde ex actionum gestionúmque differentia et ordine, instrumentorum differentiae ponuntur. Sic vniuersum corpus animae instrumentum statuimus, et visionis oculum, concoc-tionis ventrem, prehensionis manum, progressus pedes. In his verò et digitus minus est instrumentum quàm manus, et haec minus quàm brachium, hoc denique minus quàm corpus vniuersum. Quoniam verò organum non sui ipsius, sed obeundi muneris gratia est constitutum, vt opus efficiat debet apparationem quandam et instructionem in id obtinere, vnde et nomen inuenit. Est autem ea figurae concinnitas, quae sua est cuiusque, et qua adempta instrumenti ratio perimitur. Nihil enim quod rude et informe, instrumenti nomine dignum est, sed quod formatum et instructum et aptum corpus est ad opus, id idoneum illius est instrumentum. Quocirca si exquisita petetur nominum ratio, instrumentariae id est formatae parti obiicietur pars informis, et ὁμοιομερὲς ἑτερογενεῖ, atque haec oppositio est in substantiae genere, illa verò per figuram. Vnde perspicuum est eos rerum genera permiscere omniáque turbare, qui parti (vt ita dicam) simili instrumentariam opponunt, perinde atque si albo dulce contrarium facerent. Sed et ea quae diuersorum sunt generum, si enuntiantur de eisdem, palàm est contraria non esse. Atqui venas et arterias ossáque plurima simili natura cùm sint, instrumenta tamen omnes appellant ob figurae speciem. Ea nequaquam instrumenti ratio est, vt ex partium varietate concretum sit, cùm ferream securim opifices plerúmque totam exhibeant, sed vt idonea figura sit instructum. Neque demum similis corporis necesse est quoduis fragmentum totius appellatione dici. Quo errore quidam abducti, venae et arteriae tenue fragmentum, cùm viderent neque arteriam, neque venam appellari, dissimilium partium esse censuerunt, ignorantes illa non substantiae, sed figuratae substantiae nomina accommodari. Necesse quidem est similarium fragmenta similem integris substantiam obtinere, at non ilicò eadem quoque appellatione dici. Ergo hoc difficultatis vt claudatur, quaecunque in corpore pars diuersi generis apparebit, eadem mox et instrumentaria iudicetur: hoc enim natura prospexit,

parts are reckoned less and some more complex. There is a scale too when the performances and functions of the parts are looked at separately; and then, since the bodily parts are made for the purpose of tasks and actions, we can describe as an instrument and (so to speak) a resource for doing anything, the whole part through the activity of which we can produce a common action for the whole body. Next, by discriminating between one action or performance and another, we specify differences between instruments. Thus we establish the whole body as the instrument of the soul, and the eye as the instrument of vision, the belly as the instrument of concoction, the hand as the instrument of grasping, and the feet as the instrument of progression. Among these the finger is less of an instrument than the hand, the hand less than the arm, and lastly, the arm less than the whole body.

But since an organ is not made for its own sake, but to carry out a function, to do its work it must achieve some preparation and training for the role from which it draws its name. There exists an elegance of shape, of which each organ possesses its own, and its loss removes the justification for the organ. For nothing crude or featureless deserves the name of organ, but the appropriate organ for a task is the body shaped and suited to it. Consequently, if a refined justification for names is needed, a shapeless part will be contrasted with an instrumental (i.e., a shaped) part, and Homoeomerous with Heterogenous, and the latter contrast lies in the kind of substance, the former one in the shape. Hence it is clear that the kinds of things are mixed up and all muddled by those who contrast an instrumental part to what I may call a similar part, just as if they were making sweet the opposite of white. But even things of different kinds clearly are not opposites if they are expressed in the same terms. Yet since veins and arteries and most bones are of uniform nature, they are still all called instruments because of the nature of their shape. It is not an instrument's characteristic at all to be put together from a variety of parts, since craftsmen produce practically the whole of an axe out of iron, but to possess an appropriate shape. Nor does any fragment of a similar body have to be referred to by the same name as the whole. Misled by this error, some people have regarded a thin fragment of a vein and artery as among the dissimilar parts, since they saw that they were not called an artery and vein, but failed to notice that these names were applied not to a substance but to a substance with a shape.¹ It is indeed necessary that fragments of similar bodies should possess a substance like the whole, but not automatically be described by the same name. Therefore, to dispose of this problem, let any part in a body that appears of diverse kind be considered instrumental later, because nature has provided for linking some

vt particularum dissimilium compositioni, figuram et conformationem quandam coniungeret. At non sic licet reciprocare, vt quae pars instrumentaria fit, eadem statim ex varia natura constet, sitque dissimilaris.

*Quid pars corporis, et quot simplices ac similes propriè
dinumerentur. Cap. II.*

PLURIMA HABET humanum corpus continétque simplicia, sine quibus neque diu, neque conuenienter conseruari potest: vt spiritus, lac, semen, sanguinem, vtilis humores, et quae ab his defluunt superuacanea suis quibusdam receptaculis concepta: praeterea ossa, cartilagines, vincula, tendones, membranas, nervos, venas, arterias, cutem, carnem, itémque adipem, medullam, pilos et vngues: haec omnia quidem simplicia, sed quibus non ex [P51] aequo partis appellatio attribui potest. Pars enim, [*sic*; no comma in 1542] est corpus toti cohaerens communiqué vita coniunctum, et ad illius functionem vsúmque comparatum. Itaque sanguinem in venis vel humores toto corpore fusos partes non dicimus, vti neque spiritus impetu cordis impulsos in arterias: hos enim corpora in praesentia non dicimus, illi quanquam sunt corpora vti et oculorum humores, nusquam tamen haerent coniuncti, sed fluxu deerrant quasi vase conclusi. Siquis humor intus fortè concreuit, haesitque ventriculo aut lienì, quia tamen illi verè coniunctus non est, neque communem vitam accipit qua regatur, pars haberi non debet, vt neque calli, neque verrucae, neque tophi. Sed neque ex carne tumorem vndelibet erumpentem, licet alatur et viuatur, partem verè dixeris: quia praeter naturam et prodigiosè cùm sit, nullam functionem nullúmque vsum toti, sed potiùs incommodum affert. Sic neque oculi dimidium, pars est corporis simpliciter et absolutè vocanda, quòd nullam functionem nullúmque sola officium exhibeat: cuius et aliud argumentum est, quod neque organon neque ὁμοιομερὲς rectè appelletur. In horum quoque numero habendum est tenue ossis aut nerui fragmentum. Iam verò omnibus hac ceu lege quadam comprehensis, scrutemur num pili et vngues corporis partes et esse et dici possint. Illi quidem è corporis materia consistunt, haeréntque toti firmissimè, propria quadam circumscriptione definiti, neque profecto praeter vsum condonati mortalibus: attamen quòd non ita coniuncti sunt, vt communi totius vita fruantur, in partibus corporis non habentur. Non enim illi ossium aut stirpium more viuunt, nec alimento intrò adacto tractóve nutriuntur, nec incrementum in latum et profundum

configuration to the assembling of dissimilar parts. But it is not valid to turn this on its head and say that an instrumental part is automatically of diverse nature, and is dissimilar.

Chapter 2. What is a part of the body, and the correct numbers of simple and similar parts.

THE HUMAN body includes a great number of simple parts, without which it cannot survive long nor consistently; examples are spirit, milk, semen, blood, useful humors, and the superfluous materials running off from these and held in their own containers; in addition, bones, cartilages, ligaments, tendons, membranes, nerves, veins, arteries, skin, flesh, also fat, marrow, hairs, and nails; simple these all are, but the name of part cannot be given to them on an [P51] equal basis, because a part is a body attached to the whole, linked to it by a shared life, and provided for the function and benefit of the whole. So we do not describe the blood in the veins or the humors distributed throughout the body as parts, nor the spirits propelled into the arteries by the cardiac impulse; these spirits we do not call bodies for the moment, and the blood and humors, though bodies like the ocular humors too, are not attached anywhere, but run around in liquid form as though shut in a vessel. Any humor that happens to have congealed inside and has stuck to the stomach or spleen still must not be reckoned a part, since it is not really joined on, nor has it received a shared life to control it; no more are scars, nor warts, nor tophi.² You would not be correct to describe a swelling bursting out from flesh anywhere as a part, though it is nourished and alive, because it contributes no function or usefulness to the whole, but rather harm, since it is preternatural and monstrous. Similarly half an eye is not to be called without qualification a part of the body, because on its own it provides no function nor service. Further evidence of this is that it is not correct to call it an organ nor homoeomerous. To be included in the same category is a thin fragment of bone or nerve.

Now that everything has been covered by this virtual rule, let us inquire whether hairs and nails can be, and can be called, parts of the body. They certainly consist of the body's material, and cling very tightly to the whole, being limited by a boundary of their own, and certainly not granted to mankind beyond their usefulness. Yet because they are not so closely attached as to avail themselves of the common life of the whole, they are not reckoned as parts of the body. They are not alive like bones and stalks, and are not nourished by nutriment impelled or drawn into them, nor do they undergo growth in breadth and depth

vt in longum suscipiunt, sed materia quadam vice alimenti (propriè siquidem alimentum non est) illis ad radicem posita iunctaque, in longitudinem atque molem ampliorem proferuntur, haud secus atque lapides qui in terrae sunt visceribus, aut domus dum extruitur: quod ex his palàm fiet, quae de nutritione posthac dicentur à nobis. Non pauca tamen his obiici possunt. Nam pueris vnà cum digitis vngues quoque in longum atque latum increscunt, paritèrque in profundum, et aetate crassiores duriorésque euadunt. Eadem est et in pilis ratio, qui prouectis quàm pueris vt longiores ita crassiores sunt et rigidiores. Deinde verò quòd vngues et pili non crescunt in immensum, sed definitam incrementi legem et metam habent quemadmodum et stirpes, fidem facit eos vera nutritione increscere. Si enim admota duntaxat ad radicem materia atque subiecta adaugescunt, quoniam continenter suggeritur et accedit (hoc testimonio quòd derasi vel praecisi semper subnascuntur) continua adiunctione deberent tandem in immensum luxuriare atque grandescere. Atqui contrà fieri cernimus, his vt plantis constitutos incrementi limites, quos praetergredi non liceat. Quocirca his vt stirpibus videtur alimentum omnem substantiam intrò subire, quod prima aetate alit et auget: et tandem cessante incremento tantum alit. Haec quidem non mediocriter vrgent [*sic*], sed illa magis, quòd pili vel vngues praecisi omni aetate vel decrepita et praecipitata recrescunt: deinde quòd hecticis et tabidis quibus reliquum corpus non augetur modò, sed etiam planè exhauritur et liquescit, ij soli diffunduntur et grandescunt: neque his modò, sed etiam vita destitutis corporibus. Quibus apertè conuincitur non naturae attrahentis beneficio, sed excrementi redundantis vi et egressu ab radice duntaxat illos increscere. Emergit autem id praeparatum pulsúmque vi caloris, indicio quòd defunctis non semper augescunt. Quòd pueris aetate procedente in latum sparguntur, efficit partium à quibus prodierunt amplitudo: quòd verò fiant crassiores, excremento tandem sicciori adustiorique facto acceptum refertur. Quòd autem cùm ad iustam magnitudinem peruenerunt, non vltrà promitti trahique possunt, tametsi materia ad radicem suppetit, vnum ex his est in quibus non aliud quàm mirari liceat Dei et naturae prouidentiam. De medulla autem nihil ambigi potest eam quae in spinae fistula tenetur, non aliter quàm cerebrum corporis partem esse: quandoquidem non vsu modò, sed proprio quoque perfungitur munere, et vitam habet, cuius ope trahit et in se recondit alimentum. Caeterùm quae in exilibus ossium cauernis est, vt liquidi humoris speciem ostendit, ita non pars corporis est, sed ossis alimentum, quod à sanguine primùm [P52] deductum ab illius natura mox deficit,

as they do in length; material that takes the place of nutriment (for it is not properly nutriment) is placed at their root and attached, and they extend to greater length and bulk, just like stones in the bowels of the earth, or a house being built. This will become evident from what we will say later about nutrition.

A good deal however can be said on the other side. Children's nails grow in length and width along with their fingers, and in depth just as much, and get thicker and harder with age. The same applies to hair, which as well as being longer is thicker and stiffer in older people than in children. Next, the fact that nails and hair do not grow without end, but have a fixed limit of growth, like plants too, creates belief that they increase by genuine nutrition; if they grow just by the material brought to the root and placed beneath it, since it is continuously heaped in (the evidence is that they keep growing after scraping or trimming), they ought to end up proliferating and enlarging without limit. But we find the opposite: they have limits of growth, like plants, which they cannot transgress. Hence it seems that all their substance gets in as the nourishment gets into stems, that gives feeding and growth in early life, and finally just feeding, with the ending of growth. The latter [i.e., stems] thrust considerably, but the former [i.e., hair and nails] more, because hair or nails that are trimmed grow back at any age, even at the last decrepit extreme; and also because in hectic fever and wasting, when the rest of the body not only fails to grow but even manifestly drains away and liquefies, they alone spread out and enlarge; and not just in these disorders, but even in bodies deprived of life. This clearly proves that their growth is not thanks to nature attracting, but [happens] just from the force of excessive waste matter and its emergence from the root. This [matter] comes out prepared and propelled by the force of heat; the evidence is³ that in the dead they do not always grow. They become widespread in boys with increasing age, which results from the size of the parts from which they are produced. They get thicker, which is regarded as due to the waste material getting drier and more scorched. When they have reached their correct size, they cannot be pulled to protrude further, even if the root has the material for it, and this is one of the things about which one can only marvel at the providence of God and nature.

There can be no doubt that the spinal cord, which is enclosed in the vertebral canal, is a part of the body just as the brain is, because it carries out not just a task but also a specific function, and possesses life, by means of which it attracts and stores away nourishment into itself. But what is in the tiny recesses of bone, while it looks like liquid humor, is not part of the body, but the nourishment of bone, which once [P52] drawn off from blood soon departs

sensimque mutatum in ossis naturam tandem facessit. Similiter quae maiores implet ossium laxitates ut crurum ut humerorum, quanquam firmior solidiorque subsistit, alimentum tamen est ossis tanquam commeatus aliquis congenitus datúsque ab ortu, propterea quòd ossis soliditas non facìle aliud sinit extrinsecus intrò commeare. Medulla quidem vi ossis atque tepore albescit et concoquitur, raptáque sensim in ossis naturam absumitur. Quod igitur in ea laxitate manet tanquam superabundans ad futuram necessitatem, id medulla est, quam Aristoteles concoctum excrementum (sic vocant succum corporis superuacaneum) appellauit, non tamen inutile et reiectaneum. Quamobrem decepti videntur qui ut aduersas sententias in concordiam adducerent, medullae partem alteram vtilem, inutilem alteram, totam verò partim alimentum partim excrementum esse prodiderunt. Ea ne praeproperè desit, illapsi extrinsecus alimenti subsidio sustentatur, eo indicio, quòd quae in iuuentute rubro colore perfusa erat et sanguineo, aetatis progressu alba fit, et ut reliquum corpus adipata. Caeterùm illius nulla est vera nutritio, neque sanguinem prolecat sibique iungit, quòd vita nulla constet, ut neque sanguis neque quisquam alius humor. Similis est ac fortasse maior in adipe ratio, quem palàm est è sanguinis portione praepingui, hanc autem ex alimenti concoctionisque probitate generari, quae dum affluens in animalis pulpam non absumitur, sensim exaggerata in molem, è venis iam delapsa in adipem concrecit à frigido. Quòd si illius efficiens est frigidum, quomodo corporis pars esse possit? Quem confirmamus humorem in venis nondum partem esse, quì putemus extra venas frigoris vi concretum partem fieri? Si quis est huic argumento locus, videbitur similiter gelati in ventriculo sanguinis grumus, pars esse corporis, si modò illi adhaerebit. In carne ratio diuersa, quòd haec ut caeterae partes omnes non ex concrecente, sed ex conuerso mutatóque sanguine gignatur. Est et aliud quod adipem ut medullam à communi partium notione secludit: nam per inedias, per alimenti et sanguinis penuriam, cedit vertitúrque in vtile partibus alimentum. Atqui pars nulla partem alteram nutrit, neque alia alijs fit nutrimentum. Deinde omnes tum simplices tum compositae, propria quadam circumscriptione continentur, quam (tametsi in ampliorem molem diffunduntur) similem seruant, nisi praeter naturam sint affectae: adipem et medullam nulla propria circumscriptio aut figura, sed vicinarum duntaxat partium ora et extremitas circumiecta claudit. Vnde intelligi potest in partium numero et ordine non pilos, non vngues, sed nec medullam nec adipem esse. Scio

from blood's nature and gradually transfers in the end to bone's. Similarly, what fills the larger recesses of bones, for instance the leg or arm bones, is more firm and solid, yet is a supply of nourishment for bone that is inborn and provided from the start, because bone, being so solid, does not readily permit the entry of anything from outside. Marrow is turned white and is concocted by the power and warmth of bone, and is hurried off to disappear gradually into the nature of bone. Thus what is left in the recess, like a surplus for future need, is marrow, which Aristotle termed concocted waste matter (that is what they call surplus bodily juice), yet not useless nor for rejection. People therefore appear misled who seek to drag contrary opinions into agreement by holding that one part of the marrow is useful and the other useless, yet that it is all partly nourishment and partly refuse. In case it should abruptly fail, it is supported with the help of nourishment slipping in from outside, witness the way in which during youth it is pervaded with the red color of blood, but as life goes on it turns white, and contains fat like the rest of the body. But it has no genuine nourishment, and does not coax out blood and attach it to itself, because it possesses no life, nor blood nor any other humor.

The argument is the same and perhaps stronger in the case of fat, which is clearly derived from the very fatty portion of the blood, and that in turn from the goodness of the food and the digestion, which when excessive does not vanish into the fleshy part of an animal, but accumulates gradually into a large amount, and slipping out of the veins congeals into fat through coldness. If what brings this about is cold, how can it be a part of the body? If we regard a humor in the veins as not yet part of the body, how can we think it becomes one when solidified by cold outside the veins? If there is space for the proof: a clot of similarly congealed blood in the stomach will be seen as part of the body, provided simply that it sticks to the stomach. The position is different for flesh, because it (like all the other parts of the body) is generated not from congealing blood but from modified blood. There is another point that distinguishes fat, like marrow, from the general concept of parts: during starvation and lack of nourishment and blood, it withdraws and is turned into nourishment of use to the parts. But there is no part that nourishes another part, and one does not become another's nourishment. Next, all of them, simple and composite, are confined by a boundary of their own, and even if they spread into a larger bulk, they keep it the same, unless they have undergone unnatural influence. But fat and marrow have no boundary or shape of their own, but are held in simply by the edge of the adjoining parts. Hence it can be appreciated that hairs and nails are not counted nor ranked as parts, and marrow and fat are not either. I am

Aristotelem partes simplices, alias molles et humidias dixisse, alias duras et solidas: atque inter illas sanguinem, adipem, medullam, genitale semen et lac recipere: quo loco is quicquid in corpore tenetur, partis appellatione complectitur. Nos verò accuratiùs ea sequimur, ex quibus ad medendi artem fructus percipi possit. Ergo quae verè existimari debent partes simplices, hae restant: os, cartilago, vinculum, membrana, tendo, neruus, arteria, vena, caro, cutis. Satis multa de partium differentiis: vnde huc digressa est, eòdem redeat oratio.

Quid elementum, quae medicis in corpore partes elementa, et quae principia dici debeant. Cap. III.

CORPORIS VNIUERSA moles tametsi varia compositione structa apparet, sectione tamen in eas dirimitur distrahiturque partes, quae similes cùm sint, iam non vltrà in alias distribui possunt: sunt illae quasi retexendo postremae, quas simplices, sensus percipit, cogitatio autem ratióque nostra omnium primas ortu et compositione iudicat. Quare corporis elementa illas statuere conueniet. Elementum enim corpus est simplex, ex quo quidque primùm constituitur. Simplex quod distrahendo vltimum offenditur, quòdque diuisione minimum est, aut si magnitudine et mole praeditum est, in diuersas tamen species partiri nequit. Simplicium connexionem compositum emergit, cuius eas duntaxat partes elementi appellatione designamus, quae omnium primae fuerant, et ex quibus compositionis successus originem ducit. Simplicem partem [P53] antecedunt forma et ea materies quam informem nudamque intelligimus: verùm quia corpora non sunt, illas ab elementi notione abducimus. Principia quidem sunt, quae singula separatim minimè subsistunt, concursione implexúque suo corpus efficiunt. Compositis corporibus, tum principia, tum elementa insunt: sed haec quidem corporea sunt, ex principiis condita, quae et per se sola consistunt, et in totius sunt genere: principia autem simplicissima habentur, incorporea, nec in totius genere, quae seorsum minimè subsistunt, implexúque mutuo corpus instruunt. Itaque quas eiusdem naturae diximus corporis partes, si sensuum testimonio credimus, elementa sunt corporis, quae prima subiecta sunt nobis. Semen autem genitale et maternus sanguis principia statuentur, non quae componunt, sed quae corpus efficiunt: hic enim ceu materies quaedam est, illud vt causa efficiens, quod nimirum omnis generis partes conformare suo loco dicetur. Haec esse corporis elementa

aware that Aristotle said that some simple parts were soft and wet and others hard and solid, and he included among them blood, fat, marrow, genital semen and milk. In that passage he embraces by the word “part” anything the body contains. But we pursue with more precision the topics that can be seen contributing to the art of healing. Therefore the following remain that must truly be considered simple parts: bone, cartilage, ligament, membrane, tendon, nerve, artery, vein, flesh, skin. That is enough about the distinctions of the parts; let our discourse return to the point from which it digressed.

Chapter 3. What should be called an element, what parts in the body should be called elements for doctors, and what should be called principles.

THE WHOLE mass of the body appears of diverse composition, but dissection divides it into parts, and provided these are similar parts, they cannot be broken down further into different parts; they are like the final result of unraveling, which sense perceives as simple, and our thought and reason reckon them the first of all parts in their origin and composition. So it will be proper to regard them as the body's elements; an element is a simple body, from which each thing is originally made. A simple is what is met with last in taking something apart, and what is smallest in division; or, if it does have size and bulk, it cannot be split into different kinds. A composite develops by the linking of simples, and we describe just those parts of it as elements that had been first of all; from them the outcome of composition takes its start. Before the simple part [P53] come the form, and the material that we regard as without form and naked; but we exclude these from the concept of element, because they are not bodies. They are in fact principles, which barely exist as separate items, but by their running together and interlocking they make a body. In composite bodies, both principles and elements are present; elements are bodily things, made from principles, that both exist on their own, and are in the kind of everything. But principles are regarded as the simplest things, incorporeal, and not in the kind of everything. They barely exist separately, and set up a body by linking together. So what we said were bodily parts of the same nature, if we believe the evidence of our senses, are the elements of the body, which are our first subjects. Genital semen and maternal blood will be established as principles, which do not build a body, but bring it about; the blood serves as a material, but the semen acts as an efficient cause, which is described in its own place as shaping the parts of every kind. It will be wrong to say that these are elements of the

falsò quis affirmet, cùm id minimè constituent, nec in eo praeterea seruentur: eius verò causae sunt et principia. Ad hunc modum stirpis principia aestimanda sunt, semen et succus è terra libatus ac haustus: elementa, radix, lignum, medulla, cortex. Sed enim de rebus omnibus cùm duxerimus non esse sensuum ope, sed mentis acie aestimandum, non alienum sit inquirere ordinem similium partium: quae cùm sint elementa ante oculos posita, num alia quaedam sint illis priora, quae ad sensus permanere non possint: an item illis inserantur iactatae et peruulgatae quatuor illae rerum naturae, terra, aqua, aër, et ignis.

Quibus rationibus terra, aqua, aër et ignis rerum omnium elementa dicantur. Cap. IIII.

SI QUAE in natura sunt rerum omnium communia elementa, quae rebus omnibus promiscuè gignendis sese accommodent, illa sanè et plura esse necesse est, et quodammodo contraria et affectioni subiecta. Nam quod vnicum et simplex est, non habet à quo afficiatur, cùm à se ipso pati non possit. Neque plura vnus similisque rationis si fuerint, inuicem agent, sed mutuò se fouebunt tanquam vnum sint. Quinimò si fortè illis contrariae qualitates deferantur, nisi his pariter substantiae insint mutationi affectionique subiectae, suo illa congressu ne minimùm quidem mutabuntur, sed illaesis substantiis nihil dissimile sibi compositum reddent. His argumentis tanquam fustibus vis illa et turbulenta concursio atomorum immutabilium, per inane volitantium in exilium relegata, et de natura mundoque depulsa videri possit. Itaque vt ligna, lapides, et animantia, mutationem patiuntur, sic et ea facilè mutantur, ex quorum concretione haec communi ortu prodierunt. Si facilè mutabilia sunt, necesse est omnino praedita esse qualitatibus valentissimis, quarum dissidio et repugnantia non ipsae modò qualitates sese obtundant, sed et adiectorum vicinorumque corporum substantiae totae immutentur atque conuertantur. At quaenam hae sunt validissimae? Quaecunque corpori infunditur qualitas in vnum aliquem quinque sensuum cadit: atque vt suum quaeque sensum mouet, sic illi quadam proportionem respondet. Vnde cùm sit tactus sensuum primus, isque plurimùm corporeus, quae hunc feriunt qualitates omnium primae sunt et maximè corporis participes: quod certè efficit vt ab his summis doloribus afficiamur aut voluptatibus. Quocirca non candor aut nigror, non dulcedo aut amaror, non quae caeteros sensus, sed quae

body, since they are hardly constituents of it, nor are they preserved in it either; rather, they are its causes and principles. In this fashion the principles of a plant are to be regarded as seed and juice drawn up from the soil; its elements are root, wood, pith, and bark.

But when we have worked out that an assessment about everything needs the edge of the mind, not the help of the senses, it may not come amiss to investigate the standing of similar parts: as they are visible elements, whether there may be others more fundamental, which cannot penetrate to the senses? Again, whether they have associated with them those four notorious natures of things: earth, water, air, and fire?

Chapter 4. The reasoning on which earth, water, air, and fire are to be called the elements of everything.

IF THERE are elements in nature common to everything, which adapt themselves indiscriminately to bringing everything about, they must certainly be more than one, and in some way contrary and subject to influence. For what is single and simple has nothing to influence it, since it cannot be open to influence from itself. If they were to be more than one, yet on a single like basis, they will not act reciprocally, but will support each other as if they were one. Further, if contrary qualities happen to be conferred on them, then unless they possess corresponding substances capable of change and influence, they will not be in the least altered by their combination, but with substances intact they will restore their composition as before. By these pieces of evidence, acting like clubs, the well-known force and violent collision of immutable atoms flying through the void could appear banished, and expelled from nature and the world. Thus, as wood, stones, and animals undergo change, so too the elements are easily altered from whose congealing they will have taken their common origin. If they are readily changeable, they must be entirely endowed with very powerful qualities, through whose variance and antipathy not only do the qualities themselves grow blunt, but the whole substances of adjacent bodies are transformed.

But what are these very powerful qualities? Every quality that is instilled into the body impinges on some one of the five senses, and as each moves its sense, the sense responds in some proportion. Hence, touch being the first of the senses and especially physical, the qualities that strike it are the first of all and have the greatest share in the body. This is surely what causes them to bring us the greatest griefs or joys. Consequently not whiteness nor blackness, not sweetness nor bitterness, not the qualities that arouse the other senses, but those

solum tactum concitant qualitates omnium sunt potentissimae. Ex harum autem genere aliae sunt principes, aliae ex his ortae: principes, calor, frigus, humor, siccitas: ex his ortae, quae in molli, duro, crasso, tenui, laeui, aspero sunt corpore, quae variae dicuntur et quasi multiformes. Harum quippe ortus principibus illis refertur acceptus, quae omnium et primae sunt et potentissimae. Elementa igitur ex quorum concursione omnia gignuntur atque concrescunt, si conuersionibus mutationibúsque sese plurimùm exagitant, debent his ipsis qualitatibus pollere, et quibuscunque corporibus illae naturaliter summae insunt, haec ipsa in prima rerum omnium elementa asseruntur. Sunt autem ea, terra, aqua, aër et ignis. Est quidem calor summus ignis, qui ceu feruor quidam est et exuperantia caloris. Aër calidus vdúsque ceu halitus, cuius humor dissipabilis, [P54] quaedam est fluxio per cuncta rerum meabilis, leuitate subtili ambientem locum implens celerrimè. Humor aquae pergelidus quidam liquor est: vt terrae siccitas firma quaedam constantia et stabilis grauitas, quibus subsidit et suis clauditur limitibus, cùm caetera elementa non nisi externo contineri possint. Quanquam igitur quae aqua perfunduntur multò plus madent, quàm quae aëre respersa sunt, id tamen non ob pleniorē aquae humorem accidere putandum, sed quod is in crassiore fluxáque substantia positus, dum in vias recessúsque corporum inseritur, consistit, retentúsque diutiùs illa afficit, madidoráque reddit, quod aër prae tenuitate efficere nequit. Verùm mador hic quem appello, non humor est is quem disquirimus. Neque praeterea ignis inde quòd maximè desiccatur, siccior quàm terra iudicandus. Id enim non per se, sed caloris interiectu efficit, quatenus corporum humorem suo calore exhaurit ac dissipat: at terra affusum humorem combibens per se sola siccatur. Aër perinde ac ignis ex accidenti madidum linteum exiccat, vt et frequentes balneae, dum vberiorē è corpore sudorem exciunt euocántque. Sic autem qualitates hae, quatuor rerum naturis summae obtigerunt, vt quemadmodum puro igne nihil calidius nihilque leuius, sic terra nil siccior, nil grauius, ne plumbum quidem vel aurum: aquam synceram nullius medicamenti vis gelida euincit, vt neque aërem vlliùs humor. Summae praeterea sic illis insunt, vt ne minimum quidem possint augescere, remitti verò possint: quod [*sic*] argumento est eas qualitates licet summas, infinitas tamen non esse, quandoquidem infinitum nihil minuitur finita portione detracta. Est porrò sua cuique elemento retusior altera qualitas, simplex illa quidem, sed quae summum generis sui gradum non impleat. Ea in igne siccitas est caloris comes, in aëre calor, in aqua humor, frigus in terra siccitati copulatum.

that arouse touch on its own are the most powerful of all. Of their kind some are original and others are derived from them; original ones are heat, cold, wetness, dryness; derived from them are those that are present in a soft, hard, thick, thin, smooth [or] rough body, which have various names and (so to speak) many forms. Their source is regarded as due to these originals, which are both first and most powerful of all. Therefore the elements through whose running together everything comes into existence and coalesces, must predominate in these very qualities, if they are greatly disturbed by changes; and whatever bodies are naturally richest in them, are claimed as the first elements of everything. They are earth, water, air, and fire. The maximal heat is fire, which resembles heat's boiling up and over. Hot moist air is like breath; its diffusible humor is a [P54] flow that can penetrate through everything, speedily filling the environment with a delicate lightness [or smoothness]. The humor of water is a very cold liquid; similarly the dryness of earth is a firm steadfastness and permanent weight, on which it settles and is restricted by its own bounds, though the other elements can only be contained by something outside. So although things washed over with water are much wetter than those splashed with air, this is not attributable to the humor [which means moisture] of water being more abundant, but because it resides in a thicker and liquid substance while it is being introduced into the channels and interstices of bodies, it stops flowing; if it remains there longer, it works upon the bodies and makes them wetter, which air cannot do because of its rarefied nature.

But this wetness I refer to is not the humor that we are investigating. Further, fire is not to be thought drier than earth because it powerfully desiccates. It does not do this on its own, but through the intervention of heat, so far as it extracts and disperses the humor of bodies by its own heat. Earth, however, dries on its own, by absorbing the humor that is poured on. Air, just like fire, dries wet linen indirectly, as do frequent baths by evoking a richer sweat from the body. Thus these qualities have been allotted to the four natures of things in the highest degree ["summae"]: as nothing is hotter nor lighter than pure fire, so nothing is drier nor heavier than earth, not even lead or gold. There is no medicament whose cold power defeats pure water, nor does the humor of anything defeat air. Further, the qualities dwell in them in the highest degree, in such a way that they cannot increase in the least, but they can be reduced. This indicates that these qualities, in the highest degree though they are, are not infinite, since infinity is not diminished at all by the removal of a finite portion. Again, each element has another, blunter quality, a simple one, but not one to occupy the maximum level of its kind. This is dryness in fire, the heat's partner; it is the heat in air, the humor in water, the cold in earth associated with

In his quaecunque qualitates eodem nomine, eodem et illae genere continentur: atque licet eorum quibus insunt corporum ratione distent, affines tamen sunt, tum natura, tum mutationis prompta commoditate. Itaque ingentes quatuor naturae toti mundo consertae ea sunt rerum omnium primordia, quorum nobis proposita fuerat disquisitio.

*Corpus hominis, ut caeterorum omnium, ex quatuor elementorum
concretionem necti et contineri. Cap. V.*

SI QUATUOR ea sunt rerum primordia, ex quibus sursum deorsum vltro citroque commeantibus, mundi natura est continuata, necesse est eorum vicissitudine, cum reliquorum omnium, tum hominis corpus conflari, ex hisque ceu ex primis rerum initiis constare. Quod tametsi vel simplici argumentatione in medium proposita planum esse debet, inductione tamen res quasi ob oculos posita, veritatem plenius illustrabit. Vna manet omnium firma consensio, corporis vniuersitatem ex partibus diuersi generis primum constitui, deinde dissimiles has consimilium strue et compositione integrari. Iam verò docendum hasce consimiles ex primorum quatuor elementorum concursione nasci. Has quidem olim ex semine ortus sui primordia duxisse, fiet posthac promptum et obuium demonstratione, simul easdem adoleuisse materni sanguinis beneficio, qui alimenti vice suffectus est. Parentum semen ex parato sanguine factum esse extra omnem controuersiam est, adeò ut nemo qui rem perspexit, ambigat omnem partium substantiam à sanguine aut proximè aut tandem processisse. Nomine sanguinis quatuor humorum mixtam congeriem appellamus: hanc verò esculentata potulentaque ingesta nobis innouarunt. Haec porro siue animantium carnes erant, siue pisces, siue terrae fruges et stirpium fructus, à promiscua elementorum concursione aliquando sunt procreata, eo sanè ordine quem pulchrè nobis cecinit Lucretius:

Lucr. II. 874–8

*Sic tempestiuus ex imbribus humida tellus
Vertit se primum in frondes, et pabula laeta
In pecudes, vertunt pecudes in corpora nostra
Naturam, et nostro de corpore saepe ferarum
Augescunt vires, et corpora pennipotentum.* Nihil enim simplici

elemento nutriri, ut neque nasci potest. Stirpes quae prodierunt è terra, non illinc omnia [P55] traxerunt, sed si ea stirpibus alimentum datura est, necesse est humore perfundantur: vnde agricultura deductiones riuorum, agrorum irrigationes adacta necessitate excogitauit. Atqui si puram aquam terrae consperges, nihil aliud quàm lutum reddes, alendis stirpibus ineptum atque minus accommodatum.

dryness. Here all qualities within the same name are within the same kind ["genere"]; and granted that they differ because of the constitution of the bodies in which they reside, they are still related both by nature and by their ready suitability for change. And so the four great natures that are linked to the whole world are those origins of everything, which were our topic for discussion.

Chapter 5. The body of man, like those of everything else, is united and held together by the coalescence of the four elements.

IF THESE four are the origins of things, whose movement up and down and to and fro keeps the nature of the world together, it is inevitable that the body of man, like the body of everything else, is assembled by their reciprocation, and consists of them as the first beginnings of things. This must be clear even from the putting forward of a simple argument, but when the thing is (so to speak) set before us by induction, it will more fully illuminate the truth. Everyone always firmly agrees that the whole body is established originally from parts of diverse kind, and from a pile made up of the similars these dissimilar parts were then assembled. Now it must be shown that these similar parts are born from the conjunction of the four first elements. Later it will be made manifest by explanation that they derived the origins of their beginning in the past from the seed, and also that they matured thanks to the maternal blood, which was supplied in place of nourishment. It is beyond all dispute that the parental semen is made from prepared blood, so much so that no one who has looked into the matter doubts that all the substance of the parts stems from blood, either directly or after a time. We name as blood a mixed assembly of the four humors; what we take in as food and drink has renewed it for us; food and drink was formed sometime by the indiscriminate conjunction of elements, whether it was animal flesh, or fish, or fruits and vegetable produce, in just the system that Lucretius celebrated beautifully for us:

Thus first the soil, moistened by showers in season, turns to foliage, and the lush fodder changes its nature to livestock, the livestock its nature to our own bodies, and many a time our body builds up the strength of wild beasts and the bodies of the fowls of the air.

For nothing can be nourished, nor can it come to be, from one element on its own. The plants that sprout from the earth have not [P55] derived everything from it; if the earth is to give nourishment to plants, they must be drenched with humor; hence the need that drove agriculture to contrive diversions of streams and irrigations of fields. But if you sprinkle pure water on earth, you make nothing but mud, useless and ill-suited for the nourishment of plants.

Oportet igitur si quod apparabitur congruens illis nutrimentum, crassioribus naturis duas reliquas contrarias inseri et temperari. Sic neque pisces alit aqua syncera, sed quae terrae, aëris, et ignis simul est particeps. Proinde ita rerum natura¹ comparatum videmus, vt reliquorum vis et substantia in terram et aquam penetret, vtque aër et ignis inferiora perfundant, vnde rerum plurimarum exortus fieri conueniret. Itaque rerum omnium corpora à primis illis naturis et rerum seminibus deriuantur, alia quidem statim et proximè, alia longa adeò rerum serie, vt cùm multorum corporum ortus intercesserint, incredibile videatur à simplicibus illa naturis defluxisse. Quinetiam eodem omnium spectat interitus: quia natura rerum obitus conficiens, eò singula refert, vnde fuerunt accepta. Homines cùm solutis corporum vinculis è vita excedunt, quantum innati caloris dissipatur, id omne in vniuersam ignis naturam reuolat: spiritus substantia partim in ignem, partim in aëris regionem offusam nobis refunditur: profluens humor aqua rursum fit aut halitus, qui tum aquae, tum aëri confinis est: solidiores partes quibus crassior inest firmitudo, vbi sensim fuerit aqueus humor exhaustus, tandem dissolutae in cinerem et terram abeunt: neque admodum dissimilis est reliquorum in occasu comparatio.

*Nam sua cuique locis ex omnibus, omnia plagis
Corpora distribuuntur: et ad sua secla recedunt.
Humor ad humorem, terreno corpore terra
Crescit, et ignem ignes procidunt, aetherâque aether.²*

Hoc mirus Hippocrates ante natam omnem philosophiam diuino afflatus elogio³ omnium primus attigit, promulgans nimirum homine animam agente singula in propriam naturam discedere, atque in eas naturas refluere, ex quibus vnumquodque consisteret. Nam paulò antè apertè confecerat hominem non posse ex vnica re constare, cum dolore affligeretur, sed ex calidi, frigidi, humidi et sicci temperatura: quibus vtique nominibus quatuor ea quae diximus primordia, non solas qualitates complexus videtur.

*Contra iuniores qui elementorum solas vires, non item substantias in
nobis putant inesse. Cap. VI.*

VIDEMUS APUD multos iuniores puerilem verèque inanem percebuisse sententiam, qua ij vetere sprete philosophia decreuerunt, non elementorum substantias, sed qualitates duntaxat in nobis asseruari.

So if suitable nourishment is to be provided for them, the two other contraries should be introduced to the two thicker natures and balanced. In the same way pure water does not nourish fish, but water that has its share of earth, air, and fire too. Thus we see that the nature of things has arranged it that the force and substance of the others make their way into earth and water, and that air and fire bathe the lower [two], from which it was appropriate that most things originate. And so the bodies of all things are derived from these first natures and seeds of things: some at once and directly, others by a sequence so long that it seems incredible that they have stemmed from simple natures, since the beginnings of many bodies intervened. Furthermore, the death of everything points in the same direction, because the nature of things, while producing deaths, returns each item to the source whence it came. When what binds them to their bodies is broken and men depart from life, the amount of innate heat that is dispersed all wings its way back to the universal nature of fire; the substance of spirit is poured back partly into fire and partly into a region of the air that is spread over us. The humor that emerges turns to water once more, or to breath, which is allied sometimes to water and sometimes to air. The solider parts that possess a more concentrated stability, when the watery humor has finished its gradual extraction, end up dispersed into ash and earth. The disposal of the rest during extinction is very similar.

For all bodies are dispersed from all places, each to its own region, and depart back to their generations. Humor grows onto humor, earth by earthy body; fires forge fire, and ether ether.

Before all philosophy was born, the marvelous Hippocrates, inspired by divine eloquence [reading “eloquium”], was first to reach this point, evidently proclaiming that when a man breathes his last each component departs into its own nature, and flows back into the natures from which everything was put together. A little earlier he had explicitly recorded that a man cannot be composed of a single thing, since he was being stricken with pain,⁴ but from a temperament of hot, cold, wet, and dry: he is supposed to have included in these terms the four elements we mentioned, not just the qualities.

Chapter 6. Against recent authorities who believe that only the powers of elements, and not their substances, reside within us.

AMONG MANY of the recent authorities we see a childish and really foolish view has grown very prevalent: despising ancient philosophy, they have laid it down that it is not the substances of the elements, but just the qualities that are stored

Esse calidum, frigidum, humidum et siccum, ex quibus constamus, non substantiarum, sed qualitatum nomina. Nusquam synceras quatuor rerum naturas haberi, mixtionis expertes: sed neque eas quae nos circumfundunt si rei gignendae adhibeantur, species suas praeterea retinere, verum protinus euanescere, quando noua compositi forma ex permixtione succedit. Quae tanquam absurda ut funditus euertamus, decet sigillatim illa minutatimque excutere. Ergo calidi, frigidi, humidi, siccique appellatione, aliàs qualitates, aliàs verò corpora quibus inhaerescunt, intelliguntur. Corpora verò aut summis hisce qualitativis excellunt, aut depressis praedita sunt. Quae ex depressis constant vario sunt ordine, quandoquidem et panem, et carnem, et vinum, et piper, aliàque innumerabilia dicimus esse calida: uti cartilaginem, membranam, neruum et os sicca. At quae qualitativis excellunt, non ita sunt multa, sed quatuor omnino, terra, aqua, aër et ignis, quibus qualitativis exuperantiam inesse diximus. Siquis igitur hisce nominibus aliud quàm elementa significet, in tam multiplici rerum varietate perturbatus omnino et confusus erit. Quocirca credibile est celebres authores nominibus his simpliciter pronuntiatis ea corpora solum designasse, quae in suo genere excellerent. Cum ex calidi, frigidi, humidi, siccique temperatura omnium corpora constare proditum sit, quis tam caecus in contemplandis [P56] rebus est, ut qualitates puras animo concipiat? ut ex qualitativis constitui corpora asseueret? Quod afferunt illi synceras nusquam haberi elementorum naturas, ridiculum sanè est et dementiae proximum. Nam quae apud nos extant, impura tametsi fortè sunt omnia, syncera tamen vspiciam esse necesse est, quae principia sint et veluti fontes à quibus ista fluxerunt. Haec enim norma, haec regula, haec praescriptio naturae, ut omnia ordine quàm optimo ducat: atqui optimum erat et ornatissimum impura ex puris, imperfecta ex perfectis quibusdam manare. Potuit autem natura omnia sic efficere quàm optima, et mundi elementa seorsum pura uti et coelum collocare. Quid igitur illa esse prohibet, si esse possunt? Ad vniuersi medium terra simplex est, grauissima, siccissima, omnis expertis humoris: ad coeli concaua interiorèmq; faciem ignis est leuissimus et ardentissimus, neque tamen pellucidus, neque perspicuus et illustris ut noster, qui fumus quidam est accensus. Etenim tenuissimus ille cum sit, nihil solidum admixtum habet, non igitur lucere potest, lux quippe non tenuissimo, sed denso flagrante corpore effulget. Hac ratione, et quod praeterea effectio omnis ab efficiente quodam sit corporeo, à quibusdam eum neque vrere neque luculenter calefacere proditum est. Mediis autem spaciis interiecta quae sunt, extremorum mutationes turbulentas sustinent, quorum communione impuriora fiunt. Quod si extremorum confusione suam substantiam non exuerunt,

in us; hot, cold, wet, and dry, of which we consist, are the names not of substances but of qualities. Pure natures of the four things, without mixture, they say are not maintained anywhere; besides, those that surround us, if in use to bring something into being, do not retain their aspect, but vanish directly when a new form of the composite develops from the mixture. To overturn these completely as the absurdities they are, it is best to examine them singly in detail. Accordingly, the words hot, cold, wet, and dry are taken sometimes to mean qualities and at other times the bodies in which they are attached. Bodies either excel in the highest degree of these qualities, or are endowed with a lowered level of them. The latter are of varying status, seeing that we describe as hot both bread, and flesh, and wine, and pepper, and innumerable other things, such as cartilage, membrane, nerve, and dry bone. But those that excel in qualities are not so numerous: there are four in all: earth, water, air, and fire, in which we have said that a preeminence of qualities resides. So anyone who indicates by these names anything but elements will be utterly muddled by so vast a diversity of things. Consequently it is convincing that famous authors meant by these names, uttered simply, just the bodies that excelled in their kind. Traditionally the bodies of everything consist of a temperament of hot, cold, wet, and dry; who then could be so blind in his view of [P56] things that he imagined pure qualities, or asserted that bodies are constituted from qualities? Their claim that pure natures of elements are nowhere to be found is ludicrous and bordering on madness. For though all the things that exist for us happen to be impure, somewhere there must be pure things, the origins and (so to speak) springs from which the impure flowed. This is the standard, the rule, nature's instruction, so that she brings everything along in the best possible sequence; and it was best, and most distinguished, for the impure to emerge from the pure and the imperfect from the perfect. In this way nature could render everything as good as possible, and arrange the elements of the world, and heaven too, in their separate purity. What then prevents them being pure, if they can be so? At the middle of everything is simple earth, very heavy, very dry, devoid of any moistness: at the vault and internal surface of heaven is fire, very light and glowing (and not transparent and brilliant like ours, which is a sort of heated smoke). As it is extremely rarefied, it has nothing solid mixed with it, and so cannot shine, for light is not emitted by a very rarefied burning body, but by a solid one.

On this basis, and in addition because every effect is the work of some effecting body, some people have held that it does not burn or create a splendid heat. What is inserted into intervening spaces suffers the violent alterations of the ends, and grows less pure through its relation to them. But if it has not shed

palàm est iisdem exemptis puram simplicémque substantiam restitui. In summa verò etsi quae apud nos extant, vera non sunt elementa: quia tamen iis proximè accedunt à quibus olim manarunt, par vtrorumque ratio censetur. Illud autem quod aiunt elementorum formas euanescere, cùm in compositionem ea concreuerint, quantum obscurat et inquinat omnem philosophiae splendorem? Idem enim fieri putant in elementorum permistione, quod in simplici rerum transmutatione: vbi recens aliqua forma in subiectam materiam commigrat, pellitur vetus atque decedit: caeterum dum ex elementorum temperatione corpus innouatur, illorum formae nihilominus in hoc manent. Adeo vt si illis congreredientibus herba nascatur, in ea seruentur illorum substantiae: dùmque rursum herba concoctione in sanguinem, tandem verò et in carnem mutabitur, licet herbae forma intercitat noua nascente, nequaquam tamen elementorum formae exeunt, sed stabiles permanebunt quoad vlla compositi ratio constabit, quanuis non vna et perpetua permistionis proportionem. Sic enim de his statuerunt viri praeclarissimi, primus Hippocrates, qui singula quae ad gignendum confluxerunt, talem vim ait in corpore retinere qualem contulerunt: et omnia per interitum eò recedere vnde sunt accepta: quod fieri neutiquam posset, nisi pristinas illas naturas retinuissent. Huic accedit Aristoteles, qui locis compluribus elementum definiens id maximè vbique solet inculcare, quod cuique composito primum inest, et in quod vltimum corpora diuiduntur: imò et alio loco palàm affirmat in carne atque ligno aliisque similibus ignem atque terram facultate, et (vt dicere solent) potentia inesse, haecque ex illis manifestè segregari. Quòd si illorum substantiae occidissent, qui fieri posset vt demum seiungerentur? Haec sanè portentosa fuerat opinio, qua dum iuniores veterem philosophorum disciplinam permistionisque rationem assequi minimè valuerunt, ab illorum sententiis temerè defecerunt. Ne quis igitur vnquam huiusmodi captiosa probabilitate fallatur, latiùs exponenda videtur tota permistionis vis atque ratio.

Lib. de Natura
hum.

5. Metaph.

3 de Coelo. Cap. 3

De elementorum permistione diligentior inquisitio. Cap. VII.

PERMISTIONI APTISSIMA sunt ea corpora quaecunque in exiguas tenuésque portiones facìle dirimuntur, qualia sunt mollia, tenera, fragilia, liquida, subtilia: è diuerso autem dura, firma, solida, arida, crassa, omnium minimè permistioni cedunt.

its substance through their disorder, it recovers pure and simple substance when they are removed, as is common knowledge. In summary: it may be that those that we encounter are not true elements; but because they closely approach those from which they once were derived, the two are considered as on the same basis. How much has the whole splendor of philosophy been veiled and soiled by those who say that the forms of the elements vanish when the elements have coalesced into a compound? They suppose that the same happens in a mixture of elements as in a simple transmutation of things: when some fresh form migrates into a subject material, the old form is ejected and withdraws. When another body is being altered by balancing of elements, their forms do not persist in it at all. The outcome is that if grass comes into existence from their assembling together, their substances are preserved in it; and when again the grass is altered by concoction into blood and ultimately into flesh, though the form of the grass perishes when a new form comes into being, still the forms of the elements do not pass away, but will remain unchanged so long as any pattern of the composite thing exists, yet not with one permanent proportion of the mixture. This is what very distinguished men laid down on these matters, and first Hippocrates, who says that the single components that have flowed together to bring something into being preserve in the body the power they brought to it. And all things at death depart to their source, which could in no way occur unless they had retained their original natures. Aristotle concurs; in a number of places where he defines an element, it is everywhere his practice to din in very strongly what the first thing is in each composite, and into what last thing bodies are divided. Further, in another place he frankly states that in flesh and wood and other similar things fire and earth are present in faculty and (as they often say) in potentiality, and these are clearly dissociated from them. But if their substances had perished, how could they end up dissociated from them? This was certainly a monstrous belief, in which recent authorities, virtually incapable of following the teaching of the ancient philosophers and the basis of mixture, recklessly departed from their views. So in case anyone is ever misled by subtle plausibility like this, it seems best to expand on the whole power and basis of mixture.

Chapter 7. A more searching inquiry into the mixture of elements.

THE BODIES that are best suited to mixture are those that are readily divided into small thin portions: soft, delicate, fragile, liquid things, of fine texture. In contrast, hard, resistant, solid, dry, thick bodies submit to mixture least of all.

Neque verò fieri potest vt illa verè misceantur, nisi contrariis inter se pugnent qualitibus, per quas pariter agentia atque patientia mutationes conuersionésque subeant: nam neque candorem lineae, neque medendi scientiam corpori permisceri putamus. Quae igitur contraria sunt et in communi materia pugnantes qualitates acceperunt, si dirimi facilè secarique possunt, ea tum substantia tum qualitibus ad permistionem sunt accommo-[P57] data. Mistionem efficient, dum paribus quodammodo portionibus infusa temperatàque coibunt. Tum enim mutua vi et effectione pugnantium qualitatum, sic illorum substantiae totae frangentur comminuenturque, sic et qualitates omnino temperatione confusae se retundent, vt illa demum neque substantias, neque qualitates puras seruent et integras. Hae quidem nequaquam dissipatae aut extinctae oblirescunt, sed repressa duntaxat exuperantia ad moderationem mediocritatémque referuntur. Hinc corpus vnum prodit consimile, quod re ipsa simpliciter vnicum iam est: nam contraria quae in permistionem venerant non energia, id est efficacia vel actu, sed potentia duntaxat supersunt et manent. Ad hunc igitur modum perfectè fit mistio, quae est diuersorum in vnum atque idem concretio. Aqua aquae, aut vinum vino simili infusum non permiscetur. Nam licet substantiarum quaedam fit in totum perfusio, haec tamen integra manent non hebetata, quòd enim contraria non essent nequaquam seipsa mutauerunt. Neque si milij et sinapis grana, aut etiam adamantem, sapphirum, et margaritam planè leuia facta contritáque confuderis, aliam permistionem induxeris, quàm quae deprehenditur à sensu, quae potius collocatio quaedam est et quaedam exiguarum partium compositio. Rursum si lana aut spongia oleo humoréve quopiam perfunditur, tametsi non sensu modò, sed reapse confusa sunt illa, nihílque re vera fit vel minimum spongiae quod humore conspersum non madeat, quia tamen in vnum atque idem illa non concurrunt, sed suas ipsa naturas seorsum retinent illaesas, naturali permistione vacant. Imò si quatuor elementorum substantiae optimè confusae cohaerescant, nisi pugnandi vi et potestate retundantur temperenturque, in vnum minimè coalescent. Quod cùm Empedocles affirmasset elementa exiguarum partium appositu solo permisceri, id iuste Aristoteles argumentis incessiuit. Ergo iis legibus quas antè dixi obseruatis, diuersorum fiet in vnum concretio, et praeterea si viribus quodammodo paribus illa concurrant: nam tametsi reliqua consentiunt, si desit hoc postremum, mistio vtique non erit, sed procreatio. Cùm enim contrariorum vires praeter modum impares sunt, quod minus est et imbecillius, ab ampliore et potentiore victum perimitur,

They cannot indeed be genuinely mingled without mutual combat between their contrary qualities, through which, actively and passively at the same time, they undergo changes. For we do not reckon that whiteness mingles with a line, nor knowledge of healing with a body. So things that are contrary and possess antagonistic qualities in a common material, if they can be easily divided up, are adapted to mixture both by the substance they have and by the qualities. [P57] They will create a mixture when they are poured in and balanced in (so to speak) equal parts. For then the interacting forcible action of the battling qualities will so completely break down their substances, and the qualities, utterly combined by balancing, will be so blunted, that the bodies will end up possessing neither substances nor qualities that are pure and intact. The qualities are by no means dispersed to vanishing point, but with just their superiority subdued they are reduced within the limits of moderation.

Next, the body gives rise to a similar one, which is in fact already simply a unity; the opposites that had entered into mixture do not survive permanently in energy (i.e., efficacy or action), but just in potentiality. On this criterion a mixture is perfectly made when it is a coalescence of diverse items into one and the same thing. Water poured into water, or wine into similar wine, do not mix; though a sort of perfusion of substances into the whole occurs, they remain unaltered and undulled things, for not being contraries, they have not changed at all in themselves. And if you take millet and mustard seed, or even diamond, sapphire, and pearl, grind them up extremely finely and mix them, you will have brought about a mingling different from what the senses detect, which is more a kind of assembly and juxtaposition of tiny parts. Besides, if wool (or a sponge) is bathed in some oil or humor, and they are genuinely mixed and not just so far as can be sensed, and really none or almost none of the sponge goes unwetted by the humor, even then there is no natural mixture, because they do not combine into one and the same thing, but retain their own natures separate and intact.

Again, if substances of the four elements are perfectly mixed and come to stick together, they barely coalesce at all into one unless they are blunted and balanced by the forceful power of their antagonism. When Empedocles had asserted that elements were thoroughly mixed just by the juxtaposition of tiny parts, Aristotle was right to attack the assertion with arguments. Therefore accord with the laws I previously mentioned will bring about a coalescence of different items into one, and so too will their assembling with (in a way) equal forces. For even if the other conditions are met, if this last one is lacking, then there will not be mixture, but procreation. When the powers of contraries exceed the limit of inequality, the smaller and weaker is overcome by the larger

in illiúsque naturam facessit. Neque enim amphoram aquae mille amphoris vini, neque lignum igni, neque alimentum corpori permisceri dicimus, sed illa occumbere, noua autem oriri. Nisi igitur quae in temperationem trahuntur permaneant et consistent, non erit vlla connexio, sed aliquo pereunte gignetur aliud. Vnde planum fit, aliud esse miscere aliud gignere, aliud permistionem aliud ortum, et eam opinionem non posse defendi, quae elementorum substantias perire, solásque qualitates in mistione retineri arbitratur.

*Vtrum elementorum substantiae, an qualitates solae totis totae
perfundantur. Cap. VIII.*

QUANDO IGITUR mistorum elementorum substantias in concrectione haberi perspicuum iam est, inuestigatione dignum videtur, vt illorum apta fiat adhaesio mutuáque complexio. Corporum substantias totas totis commisceri ac penitus in sese penetrare, multi ex Plotino opinati sunt. Qui cùm viderent sudores è cute nostra emanare, neque illam perfodi vel secari: rursum lanam aqua perfusam permadere totam, affirmare non dubitauerunt totum corpus in mistione per aliud totum penitus induci, ipsúmque quoquouersum subire, materiam materiae iniici, molémque moli. Etenim aquae materiam in lana esse dixerunt, non quibusdam modò inanibus spaciis conclusam, sed per totam illius substantiam fusam: tota enim madet, nec vlla pars eius expers est humoris. Ad hunc modum non solùm quatuor elementorum qualitates, sed eorum quoque substantias permisceri in compositione partium similarium prodiderunt. At verò ista quí possint sibi constare, concipere arduum est, et supra captum cogitationis. Dum in corporibus macerandis humor solidioris substantiam peruatit, manifestum est et apud omnes in confesso, maiorem toti molem accedere. Nam et lana madefacta occupat locum ampliorem. Quod si est, necessarium consequitur, aliam alio situ collocari materiam. In quibus verò non amplior videtur moles euadere, ceu [P58] liquore perfusis cineribus, aut cuticula sudante, necesse est quos vocant poros et angustas vias latere, in quibus aër, aut spiritus tenuior, aut aliqua materia cùm esset, exhalatur, cedénsque liquori ingressum praebet. Si enim nullum interuallum medium intercipitur, quomodo fieri posse credemus, vt in solidum et vndique inaccessum aliud corpus penetret, nisi consectiones vtrinque fiant, quà demum transitus sit?

and more powerful, passes away, and departs into the nature of the latter. We do not say that a bottle of water is mixed with a thousand bottles of wine, nor wood with fire, nor food with the body; we say the former pass away, and new things arise. Consequently, unless things carried into modification persist, there will be no association between them, but with the demise of one, another is brought into existence. Hence it is evident that mixing and bringing into being are different, so are mingling and birth, and it is impossible to defend the view that the substances of elements pass away, and only their qualities are preserved in a mixture.

Chapter 8. Whether the whole of the substances of elements pervades everything completely, or only the whole of their qualities.

WHEN IT is now clear that the substances of mixed elements are present in coalescence, it seems worth inquiring how their mutual attachment gets arranged. Many people have adopted the view of Plotinus that the substances of bodies mix, wholes with wholes, and penetrate right into each other. When they saw sweat emerging from our body, without perforating it, and also that wool soaked with water is totally wetted, they did not hesitate to assert that in mixture a whole body is drawn completely through the whole of another one, and itself sinks below the surface in every direction; material is inserted into material, and bulk into bulk. They said that the material of water is in the wool, not just enclosed in some empty spaces, but diffused through its whole substance; for the whole is wet, and no part of it is without moisture. They held that not only the qualities of the four elements, but their substances too are mingled to this degree in the assembling of similar parts. But how these [parts] can hang together is hard to imagine and beyond the mind's grasp. When moisture enters into the substance of the solid part during the steeping of bodies, it is obvious and universally accepted that a greater total mass accrues: the soaked wool takes up more room. If this is so, it inevitably follows that some material is taking up another position. But where no larger bulk seems to develop, as with [P58] wetted ashes or sweating skin, the so-called invisible pores and narrow passages must be present, in which air, or thinner spirit, or some material existed; it is exhaled, and gives room for the entry of liquid. If there is no intervening gap, how will we think it possible that another body can make its way into a solid without means of entry on any side, unless slits develop on each side where a passage through can occur?

Atqui si hoc modo corporum substantiae totis immiscentur, fit saltem illorum ad vsque minima diuisio, sic vt huius minimum corpusculum, illius minimam particulam contingat: id certè indignum philosophia videri solet, credere aliquid esse in rerum natura minimum, quod diuidi nequeat. Omne quidem corpus sectione infinitum est, neque ad extremum et indiuiduum perducì potest diuidendo. Quinetiam si illuc veniri potest, continua fractione comminutioneque facta, corporum substantiae in sectiones absumentur, et tanquam in nihilum redactae se mutuò destruent. Ad postremum verò quum exiguum quiddam permiscetur maiori corpori, quomodo vsqueadeo distendi aut secari poterit, vt per vniuersum maius se diffundat, et cuique indiuiduo huius aliud indiuiduum minoris accedat? Fieri igitur non potest, sed ne intelligi quidem, vt corporum substantiae mutuò se penetrent, et eodem prorsum situ constitutae sint et collocatae: nec fieri potest vt in ampliorem molem diffusae per minimas sectiones consertae colligantur. Rationes istae fortasse Auerrhoidem eò necessitatis adegerunt, vt non commentitium quiddam modò, sed somnio quoque similimum adferret: qui vt hanc substantiarum permisionem tueretur, elementorum formas à perfectarum substantiarum dignitate et vniuerso genere detorsit, vt non in qualitates, sed in medium quoddam et inauditum genus transferret. Illas quidem intendi posse et remitti per eandem materiam aequabiliter fusas, qualitatum comparatione et exemplo pariter exporrigi. Cuius opinionis leuitas alio loco à nobis refutata, fusiorem hìc disputationem non desiderat. Quocirca missis lubricarum opinionum fluctibus atque iactationibus, in tutum et tranquillum portum nos recipiamus. Elementorum substantias mistio totis totas non inserit, sed qualitates duntaxat miscet atque confundit, vt per totius compositi molem aequabiliter sint fusae. Primùm enim quatuor illae mundi simplices naturae dum paribus quodammodo viribus confluunt, in exiguas non autem quamminimas portiones se distrahunt, eoque se ordine componunt, vt quaeque tandem alterius diuersique generis cuipiam cohaerescat, nihilque sensu notari possit quod non ex quatuor earum portionibus constet. Hoc positu exiguae portiones, suam formam, qualem ante permisionem, integram quaeque retinent: neque enim intensionem neque remissionem substantiae ferunt. At verò elementorum qualitates contrariae totis totae se permiscunt, et mutua quadam repugnantia sese vicissim ad moderationem quandam redigunt, fitque illarum confusione temperamenti quoddam simile genus per vniuersam compositi molem diffusum. Quanquam igitur substantiae καθ' ὅλου temperari nequeunt, sed duntaxat

But if the substances of bodies undergo complete mingling in this fashion, the bodies get divided into the smallest parts, so that the smallest tiny body of one touches the smallest particle of the other. It is certainly usually thought unworthy of philosophy to believe that there is anything in the nature of things so small that it cannot be divided. Every body is without limit in cutting, and cannot be divided to bring it to an ultimate indivisible. What is more, if that point can be reached by continuous breaking and grinding, the substances of bodies will be removed into the cuts, and will be reduced to nothing (so to speak) and destroy each other. But ultimately, when something tiny is mixed with a larger body, how can it be stretched or cut up enough to spread itself throughout the whole larger body, and add a further indivisible bit of the lesser body to each indivisible bit of the larger body? Hence it is impossible, and not even intelligible, that the substances of bodies should interpenetrate each other, and get located in just the same site. It is also impossible that they should be cut up very small and spread into a larger bulk, yet be assembled in continuity. These considerations perhaps so constrained Averroes that he made a proposal not just fanciful but also very dreamlike: to preserve this mixture of substances, he changed the forms of the elements from the status of perfect substances and from a universal kind, converting them not into qualities but into some intermediate unprecedented kind. They could, he said, be allowed to stretch over the same material, evenly spread, and extend equally, on the pattern of qualities. We have refuted this superficial view elsewhere; it does not need more extended treatment here.

So let us bypass the tides and tossings of shifting opinions, and resort to a safe calm haven. Mixture does not introduce the substances of elements whole into [other] whole substances, but mixes just the qualities, so that they are evenly spread through the mass of the whole composite. Firstly, when those four simple natures of the world assemble with somehow equal powers, they break up into small but not very tiny portions, and arrange themselves in an array such that each ends up attached to some portion of another and different kind, and nothing can be detected by the senses that is not made up of portions of these four. Through this arrangement small portions each retain their form unaltered as it was before mixture, and undergo no stretching nor relaxation of their substance.

But contrary qualities of elements mingle as wholes with wholes, and by their mutual antipathy they bring each other in turn to some restraint; their combination produces a sort of similar kind of temperament spread through all the mass of the composite. So though substances cannot be completely balanced, but only

continua appositione connecti: qualitatum tamen consummata est permistio. Quúmque haec absoluta fuerit, temperamentum accedit aequabiliter toti conspersum, et noua protinus forma inducitur: ac tum verè efficitur diuersorum in vnum atque idem concretio. Quoniam enim à forma et eius vi totum subsistit, consentaneum est id ipsum ab vnica et consimili, vnum simpléxque fieri. Quae porrò in hoc genito simplici corpore manent exiguae elementorum portiones, suis quidem formis integrae subsistunt, non tamen liberae aut sui iuris, sed implicitae, vinctae, et quasi interceptae mutua qualitatum pugnantia, atque etiam dignioris formae praesentia. Vnde pristinas sibíque inditas vires expromere non valent, neque ignis vrere, neque aqua impendiò refrigerare. Solùm igitur potestate insunt: atque sic vt cùm temperamento per obitum dissoluto ad se redibunt, partésque propriis elementis reddentur atque restituentur vniuersitati, nullius imperio obstrictae in libertatem vindicentur resumántque pristinas vires. In hunc modum mistae temperataeque elementorum portiones, materia fit totius simplici formae substrata. Haec autem forma seu perfectio sui vbique persimilis est adeò, vt non modò particulae quae sub aspectum recidunt, et quae ex tenuibus elementorum portionibus constant, sed et ipsa elementorum fragmenta, quae seorsum non [P59] aliis permista substantiis intelligimus, totius speciem gerant. Mistum enim iam est horum vnumquodque, totiúsque temperamentum accepit: nihil igitur prohibet quò minus compositi totius species immigret in omnia. Neque verò flagitium est fateri duabus illa formis ornari, quarum vna actu praesentíque imperio, altera ad tempus abrogata et antiquata, potestate duntaxat insideat. Ergo quae fuerant olim diuersa, ignis, aër, aqua, et terra, nunc in similaris corporis compositionem dum confluunt, eandem similitudinem speciémque gerunt, omniúmque fit in vnum atque idem concretio. Haec fuerit nobis tanquam leuis armaturae prima disputationis excursio, quae simplices rerum naturas persequuta sic coëgit, vt in ὁμοιομερῶν compositionem coniecerit omnes ac illigauerit.

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linked by uninterrupted attachment, qualities undergo complete mixture. When this is perfected, a temperament accrues that is spread evenly overall, and a new form supervenes at once; then a coalescence of different components into one and the same thing is really brought about. For since the whole thing depends upon a form and its power, it is appropriate that it should be made simple and a unity by a single similar form. Further, the small portions of elements that persist in this simple body brought into being depend intact upon their own forms, but not as independent items or in their own right; they are entangled, in bonds, and in thrall to the mutual antipathy of the qualities and also to the presence of the more important form. Hence they are unable to deploy the powers with which they were originally endowed, nor to burn by bringing fire into play, nor to chill by bringing water into play. The powers are there only in potentiality, and in the way that they will revert to themselves when the temperament is broken at death and the parts are restored to their own elements and to the universe, they are set free from the constraint of any control and recover their original powers. Portions of elements mixed and balanced in this fashion become [reading “fiunt”] the material that underlies the simple form of everything. This form, or ideal state, is so identical everywhere that not only visible particles made from slender portions of elements, but also element fragments themselves that we grasp mentally as separate and [P59] unmixed with other substances, exhibit the form of the whole. For each of these is mixed already, and has acquired the temperament of the whole; so there is nothing to prevent the form of the whole composite entering into everything. It is no disgrace either to maintain that things are endowed with two forms: one is in operation and in effective control, the other is out of action for the moment and out of date, present in potentiality only. Therefore what had once been different things, fire, air, water, and earth, now combine into the composition of a similar body; they show then the same likeness and form, and there is a coalescence of everything into one and the same thing. This will end the first sally of our discourse, a light-armed one, that pursued and rounded up the simple natures of things in such a way as to assemble and bind them all into the composition of Homoeomers.



DE TEMPERAMENTIS. LIB. III.

*Quid temperamentum, utque id perperam
definierit Auicennas. Cap. I.*

ELEMENTORUM CONFINIO proximè iuncta est atque connexa temperamenti proprietas, quae quodammodo propago et soboles permistionis est. In hac cognoscenda atque tractanda rerum continuata series expostulat, ut ab elementorum vi et natura rursum exordiamur, et ab ea maximè qua modò ac planè paulò antè destitimus. Simples mundi naturae quò in permistione integrae et incolumes seruarentur, et ne si pauca multis, aut parua magnis componerentur, debiliorum casu ea quibus multum esset roboris ac virtutis potius accrescerent quàm perfunderentur, aequales quodammodo esse debuerunt. Hanc aequabilitatem non magnitudine molis, non pondere metiri licet, quòd terrae quàm caeterorum elementorum vberior est in nobis copia: sed potestatis vi et efficientia, cui omnia planè accepta referuntur. Vis autem ea atque facultas non nisi efficientium et principum qualitatum quae in mistis elementis sunt, observatione aestimatur. Hae perrarò vsquequaque, saepius quodammodo pares confluunt, nempe mediocritate quadam, quae non utique indiuidua, verùm latitudine definita limitibus coërcetur, in quorum ambitu mistio contineatur: hos autem vltra citràque interitus est atque dissipatio. Quae igitur intra mediocritatis huius limites inciderit principum qualitatum concursio, ut mistionem sic et continuò temperamentum progignit. Est autem temperamentum, non ipsa mistio, sed mistionis ratio. Poterit et id earum quae in mistis elementis sunt principum qualitatum harmonia et concentus definiri. Ut in cantu et fidibus soni longis locorum interuallis distracti, aut coniuncti quidem, sed dispaes et non pro rata portione distincti, concentum haudquaquam efficiunt, nisi primi cum vltimis temperati, et mediij vtrisque respondentes aequabiliter dulci sono aures compleant: ita neque diuulsorum elementorum qualitates, neque coeuntes illae quidem temperamentum efficient, nisi



BOOK 3

THE TEMPERAMENTS

Chapter 1. What a temperament is, and how Avicenna defined it wrongly.

THE SPECIAL nature of a temperament is closely linked to the border it shares with the elements, and is in a way the fruit and offspring of a mixture. In learning and considering it, to preserve the continuity of things we require to start again with the power and nature of the elements, and particularly where we have just left off, clearly a short time ago. To keep the simple natures of the universe intact in a mixture, and supposing few things were combined with many or small things with great, the natures ought to be equal in some fashion, to prevent strong and powerful things growing through the collapse of weaker things, rather than being pervaded. It is wrong to assess this equality by size of bulk or by weight, because there is in us a richer supply of earth than of the other elements; it ought to be assessed by the power and effectiveness of its potentiality, to which everything is clearly related. This power and faculty is assessed only by watching the efficient and original qualities in mixed elements. These very rarely assemble as equals in all respects: more usually they do so in a particular way, presumably by an avoidance of extremes, which is kept within limits not through being indivisible but through a restriction of its extent; the limits are those inside which the mixing is to be contained; on either side of them is extinction and dispersal. So the assembly of original qualities that falls within the boundaries of this avoidance of extremes produces mixing, and directly a temperament as well. The temperament is not the mixture itself, but the pattern of it. It will be able to be specified as the harmony and concord of the original qualities in the mixed elements. In singing and lyre-playing, tones separated by wide intervals,¹ or close together yet ill-matched and not a valid ratio apart, do not make a concord at all, unless the first are blended with the last² and those in the middle agree equally with both of them, so that they fill ears with sweet sound. In the same way a temperament will not be created by the qualities of separated elements or by qualities coming together, unless they

moderata et concordi quadam mediocritate sese mutuò complectantur. Non igitur ipsa rerum primordia per se et absolutè perpensa temperamentum sunt: neque illorum mistio, sed mistorum comparatio. Tametsi reipsa et subiecto finitima sunt et plurimùm consentiunt elementorum mistio et eorum proportio, rationibus tamen illa disiuncta sunt. Non desunt qui temperamentum à mitione hoc discrimine seiungunt, quòd haec maximè elementorum propria sit, illud verò qualitatum. [P6o] Nos autem illa tametsi quodam ordine se consequi videmus, sic tamen iuncta sunt, vt neque mistio citra efficientium qualitatum opem, neque sine elementorum omnium substantia temperamentum induci possit. Non enim si quis aquam et ignem paribus quodammodo portionibus coire statuat et coalescere, mutuáque repugnantium qualitatum vi temperationem quandam inferri, ea protinus temperamenti rationem subeat, vt neque ex duobus illis facta perfusio, exacta mistio censetur. Perfectum enim non est, sed inchoatum atque mancum, quod ex duorum triúmve duntaxat elementorum connexione fit: cuiusmodi est plurimum genus eorum, quae ex sublimi deturbantur, μετέωρα Graeci vocant. Quocirca temperamentum concentus quidam est quatuor principum qualitatum, ex omnium elementorum permitione. Hanc temperamenti rationem cùm minimè perspiceret, nec satis animo complecteretur Auicenna, subabsurdam commentus est definitionem: qua primarum qualitatum effectione mutua, quintam qualitatem eámque simplicem emergere confirmat, quae vna superstes reliquis in congressu pereuntibus, omnium vires potestate complet, easque quasi suo sinu complexúque recipit. Id autem quàm absonum sit quámque secum pugnet hoc imprimis patefacit, quòd fieri nequit vt omnes per actionem qualitates dissolutae euanescant, neque non ea tandem superet, quae validior cùm esset conflictus principia dedit. Sed esto, donemus hoc exorto temperamento omnes illas periisse: quaenam tum restabit in genito corpore contrariorum repugnantia? Si plura illi non insident atque ea contraria, quí fiet temperamenti per singulas aetates conuersio? Quae insita erit illi causa morbi, senij, vel interitus? Adde quòd neque dum corpus dissolutione occidet, poterunt simplices naturae in vniuersitatem recurrere suis instructae qualitatribus. Illas enim vnde sibi resument, quae iam dissipatae in composito non manent? Itaque nouam illam qualitatem pro temperamento inuehere, cùm vanitas quaedam sit opinionis, quae multorum animos imbecilles diu multúmque vexauit, nos clarissimorum

embrace each other with a controlled and harmonious avoidance of extremes. So the elements of things, by themselves and weighed out perfectly, are not a temperament, nor is their mixture, but a balance of mixed things is. Even though in fact a mixture of elements and their proportion are allied to the subject, and in closest agreement, the elements are still dissociated in their patterns. There are people who separate temperament from mixture by the distinction that mixture particularly involves elements, but temperament concerns qualities. [P6o] Although we see that these follow upon each other in a kind of order, yet they are so closely linked that mixture cannot be produced without the aid of active qualities, nor tempering without the substance of all the elements. For if someone declares that water and fire meet and combine in (after a fashion) equal parts, and some tempering be introduced by the interaction of antagonistic qualities, the tempering would not fully take on the pattern of a temperament; nor is a perfusion made from these two [presumably water and fire] regarded as a completed mixture. It is not finished, but incomplete and feeble, because it comes about by the meeting of just two or three elements; the most frequent kind of things hurled down from above is like this, and the Greeks call them meteors. Consequently a temperament is a sort of harmony of the four original qualities, from a mixture of all the elements. Avicenna, barely discerning or adequately grasping this pattern of a temperament, fabricated rather a ridiculous description: he asserts that a fifth quality, a simple one, emerges through the interaction of the primary qualities, and surviving alone when the rest have perished in coming together, makes up the powers of them all by its potentiality, and (so to speak) embraces them in its bosom. How discordant and self-contradictory this is becomes particularly evident from the impossibility of all the qualities involved breaking up and vanishing during the proceedings, without one triumphing in the end that, being stronger, produced the origins of the collision. All right, let us grant that when this temperament developed all these qualities perished: then what opposition of contraries will remain in the body that has been produced? If there are no more present in it, contrary ones, how will change of temperament happen from one age to another? What will there be in it to bring about disease, old age, or death? Another point: when the body falls prey to dissolution, the simple natures will be unable to return to the universe provided with their qualities; where will they [the qualities] recover them [the elements] from, when they [the qualities] are dispersed and no longer present in the composite? And so introducing this new "quality" to replace "temperament" is a silliness that has long and greatly troubled the weak minds of many people: we follow the most distinguished

philosophorum imitatione, vt elementorum substantias, sic omnino et qualitates in composito teneri fatemur, ex harúmque perfusione et concentu temperamentum consistere.

*Contraria in idem confluere, et vnde singulorum vires
aestimantur. Cap. II.*

QUAM ILLAE variè comparari soleant: aestimari certò non antè potest, quàm sigillatim cuiusque vires quantae sint expenderimus. Auerrhois vt est in omnes ferè contumeliosus, sic et Galenum erroris falsò insimulauit, quòd summas elementorum qualitates in temperatione haberi censuerit. Haec dum paucis immutatis corrigere vult, omnia deprauasse videri potest, qui tum species, tum qualitates elementorum ad mediocre quiddam in concretione retundi reprimíque putat. In illa formarum remissione quantum sit lapsus, perpensum à nobis alio loco est. Nunc verò si qualitates summas in confusionem quandam adductas, ait sese mutuò posse ad mediocritatem deducere, cur non similiter sese prorsus interimunt? Sunt sanè media haec vti et summa inter sese contraria [sic; read “contraria” with 1542]. Scio opinionem quandam apud neotericos peruulgatam esse, qua illi instant atque vrgent summo cum studio, contrarias qualitates remissis quidem gradibus conuenienter congruentérque concurrere, summas verò haudquaquam posse: neque tamen vlla in id probabilitate se muniunt. Si enim repressae qualitates peraequè inter se pugnant ac summae, neque modò extremis extrema, sed et media mediis aduersantur, cur eae quàm summae potiùs in idem coibunt? Quemadmodum calor numeris quatuor definitus, et frigus pari recessu constitutum, cùm miscentur teporem ingenerant, sic prorsus accidere compertum est, si extremis illa numeris concurrant. Nam aqua quae ex feruentissima et aequè gelida paribus portionibus permiscetur, mox tepescit, ac si ex mediocribus temperaretur. Quis enim eò impudentiae veniat, vt in eo tepore extrema derепente aboleri dicat? Nónne palàm confirmat Aristoteles media extremorum copulatione congressúque nasci, hócque vno à priuantibus, quae στερητικὰ dicunt dissidere? Nihil aliud teporem esse iudices, quàm calidi frigidíque pari portione confusionem. Ergo si summas elementorum [P61] qualitates in permisionem et temperamentum coire Galeni fert opinio, non illa iacet suis patrociniis destituta: sed praeter commemoratas hac se fulcit sustinétque ratione, quòd aequales quodammodo esse cùm debeant, non magnopere sese valent

philosophers in maintaining that both the substances of elements and the qualities are completely held in the composite, and that the temperament arises from their pervasion and harmony.

Chapter 2. That contraries gather into the same thing, and how the powers of each are to be judged.

HOW DIVERSELY they are usually compared certainly cannot be judged until we have measured up the powers of each singly. Averroes, insulting to practically everyone, similarly accused Galen falsely of a mistake in thinking that the highest qualities of elements were available in a temperament. In seeking to correct these views, and leaving little unchanged, he can be regarded as having ruined everything, by supposing that in solidification both the forms and the qualities of elements are blunted and reduced to a moderate level. We have discussed elsewhere how much he erred in that relaxation of the forms. Now, if he says that the highest qualities are in some confusion and can reduce each other to a moderate level, why do they not likewise destroy each other completely? Certainly moderate and highest things are contrary to each other. I am aware that recent authors have put about a view in which they very eagerly insist that contrary qualities can lose their places in the scale and meet consistently and appropriately, but the highest qualities cannot do so at all. Yet they do not protect themselves by any semblance of truth; if reduced qualities are as mutually antagonistic as the highest ones, and there is opposition not just between extremes but also between moderates, why do reduced qualities unite into one more than the highest ones do? Heat is described with four stages, and cold is endowed with a similar withdrawal; on mixing they create tepidness, and it is found that this is indeed what happens if the ones at the extreme stages come together. A mixture of equal parts of very hot and of equally chilled water grows tepid before long, and if one were made from moderate waters it would be balanced. Who could get so shameless as to say that in this tepidness the extremes are suddenly abolished? Does not Aristotle say explicitly that the moderate is born of the combination of the extremes, and differs in this one respect from “negatives,” which are called *steretika*? You may decide that tepidness is simply the mingling of equal parts of hot and cold. [P61] Therefore, if it is Galen’s view that the highest qualities of the elements combine into a mixture and temperament, that view does not languish without advocates; besides those already covered, it relies on the point that since they [presumably the highest qualities] ought to be in a way equal, they have no great power to

commutare atque infringere: quocirca permanent quales fermè puris simplicibúsque elementis insidebant, hoc tantùm discrimine, quòd nunc per totas confusae eandem communémque materiam obsident. Quod ab Aristotele scriptum videmus, summas in permistione qualitates summam vim concursu adimere, et adusque moderationem quandam reprimere, de viribus id omnino accipiendum nobis est. Nam qualitates tametsi nullo modo repressae sunt, contrariarum tamen perfusione quasi vinctae inhihentur, ne suas summas vires exhibeant: hinc virium acumina exuperantiásque retudisse perhibentur. Ita contraria eodem subiecto contineri inficiamur, idcirco sanè quòd simul illa vna eadémque sede dominari et excellere nequeunt, neque quicquam possit à contrariorum vtroque nomen obtinere, sed ab eo duntaxat cuius vis praestat atque vincit. Vbi longo interuallo impares concurrunt qualitates, addubitare non licet mox à praecellente infirmiolem obliterari, nec continenter esse vno et eodem statu. Quinetiam quae in permistionem et temperamentum venerunt, quodammodo pares, etiam si per initia non luculenter se vicissim demoliuntur, diuturnitate tamen et dierum numero, disparili proportionem euadunt. Sic per aetates temperamentorum incidit conuersio, sic morborum, sic senij et occasus ingentam nobis causam circumferimus. Hactenus Auerrhoidis cauillatio effecit, vt in haec si non praeter rem, longiuscula tamen oratione diuerterim. Sed quàm commentitia fuerit et futilis illius contentio inde perspicitur, quòd siue summas in permistione qualitates, siue illarum duntaxat dimidia manere statuamus, eadem vtroque proportio constabit, idémque temperamentum: nam quacunque proportione fuerint integra, eadem erunt et illorum (vt ita dicam) medietates. Sed labor fortasse longiùs, eò reuertar vnde huc declinauit oratio. Quae in misto corpore nectuntur elementa, neque suae molis pondere, neque qualitatum ordine siue gradu, vt qui omnibus summus inest, sed virium comparatione temperamenti speciem proferunt. Vires autem qualitatis ordinem eiúsque in substantia molem, neutrum verò seorsum consequuntur, sed ex vtrisque spectantur et consistunt. Qui enim in pusillo igne inest calor, eodem est ordine atque qui in ampliore consistit: minùs tamen calefacit, quia non parem molem obtinet. Contrà autem ignitum candénsque ferrum tametsi depressiore quàm flamma est calore, vehementiùs tamen et acerbìus vrit, quoniam densa multaque substantia praeditum est. Neque igitur cui intensus est calor, id statim acriùs calefacit, quàm cui depressior est: neque quod fusum et ampliorem consequutum est calorem, id impensiùs calefacit,

change and impair themselves. Consequently they remain the way they were when present in almost pure and simple elements, with this one difference, that now, spread out over all the qualities, they occupy the same common material. We see what Aristotle wrote, that the highest qualities in a mixture seize the highest power by their conjunction and restrain it to the point of some control; we must completely accept this on the matter of powers. For even though qualities are not restrained at all, they are held in a kind of bondage by perfusion of contraries, to prevent their displaying their highest powers. Hence they are regarded as having blunted the sharp preeminence of their powers. Thus let us deny that contraries can be held in the same subject, really because they cannot predominate together in one and the same situation, and nothing can possess a name from both of two contraries, but only from the one whose power prevails. When qualities differing by a wide interval coincide, it cannot be doubted that the weaker will presently be annulled by the stronger, and does not continue in one and the same state. Furthermore, qualities that have entered into a mixture and temperament as (in a way) equals turn out in unequal proportion with the passage of a number of days, even if at the start they do not admirably abolish each other. This is the way a change of temperaments befalls as life proceeds, this is the way we carry along the cause inborn in us of diseases, old age, and death.

So far, Avicenna's quibble has made me digress into this, with a rather long discourse, though not an irrelevant one. But it can be seen how bogus and pointless his position was, since whether we decide that the highest qualities in a mixture persist, or just the halves of them, either way the ratio and also the temperament will be the same; in whatever ratio they stood as wholes, their intermediate parts (so to speak) will stand in the same. But maybe I am slipping too far; I shall return to the point from which I digressed to here. The elements that are bound in a mixed body are not bound by the weight of their bulk nor by the rank or degree of their qualities (this being the highest in all of them), but they present the form of a temperament through the combination of their powers. The powers result from the rank of the quality and its bulk in the substance, but not from either separately: they are assessed and reckoned from both. The heat in a little fire has the same rank as that in a bigger one; but it gives less heat, because it does not occupy the same bulk. In contrast, glowing red-hot iron is of a lower heat than flame, but causes stronger and harsher burns, because it is provided with much solid substance. So what possesses intense heat does not automatically burn more severely than what has less. Nor does what has acquired extensive and more widespread heat produce more

quàm cui in angustum est coërcitus, sed vtrinque virium vt dixi robur aestimandum. Id autem cùm animo et cogitatione complecti difficilè atque arduum videretur, medici iuxtà ac philosophi sensibus tanquam incorruptis et integris iudicibus confirmandum duxerunt, omnium vires ex efficientia et operibus tactu conuenienter aestimantes.

Temperamentorum differentiae quot qualèsque sint. Cap. III.

HUNC IN modum separatim examinatae vires, si deinde in communionem et societatem relatae comparentur, temperamentorum differentias ostendent. Quatuor naturarum cùm aequales vires in vnum coierint, vt calidi, frigidi, humidi, siccique pares sint portiones, temperies illa conficietur, quam temperamentum iustumque temperamentum dixere, caeterorum legem et regulam. Quodcunque autem ab hoc desciscit, et disparibus inter se elementorum viribus continetur, intemperatum immoderatumque appelletur et intemperies. In ea dispari copulatione necesse est omnino, aut vnum reliquis tribus excellat, aut ad summum duo, tria nunquam possunt. Cùm igitur quatuor sint ea, ex quibus temperamentum absolutè conficitur, singulorum exuperatione simplices quatuor creantur temperaturae: calida quidem in qua calor frigori antecellit, humoris autem et siccitatis aequalitas est: frigida in qua frigus vincit atque dominatur: [P62] humida cuius humor primas obtinet: sicca vbi humore siccitas potentior est, paribus iis quae in altera oppositione sunt contrariis. Quatuor sunt et coniugatae temperaturae, quae duorum simplicium exuperantia processerunt sèque extulerunt. Nam duae cùm sint oppositiones limitibus quatuor conclusae, neque vnus vtraque possit extremitas principatum obtinere, sit necessariò vt non plures duabus excellent. Eodem rationis momento fit, vt quauis sex numerando percenseantur coniugationes, illarum tamen quatuor duntaxat possint natura consistere. Hae sunt calida et humida, calida et sicca, frigida et humida, frigida et sicca: quas coniugatas quatuor temperaturas aut compositas appellant. Nouem igitur sunt temperamentorum genera, quae permisionis differentias et proprietates consequuntur: vnum temperatissimum, quod paribus omnium conflatum portionibus extremorum medium possedit. Intemperata octo: simplicia quatuor, totidem composita. Temperatissimum quod est, indiuiduum et omnis expers latitudinis quasi punctum intelligitur: caetera quae ab hoc recesserunt, longè latèque fusa sunt: neque enim quae calida dicimus, omnia pari à mediocritate interuallo distant, neque aut frigida, aut humida, aut sicca, vno eodèmqe omnia sunt ordine. In compositis

extreme heating than what has the heat concentrated; in each case, as I said, the strength of the powers should be reckoned. Since it seemed an uphill task for the mind to grasp this, doctors along with philosophers considered that it should be confirmed by the senses, acting as honest brokers, assessing the powers of everything according to its effectiveness and actions by a suitable use of the sense of touch.

Chapter 3. The number and nature of distinctions between temperaments.

IF POWERS are brought into close association for comparison, and examined in this way, they will display the distinctions between temperaments. When equal powers of the four elements have assembled together so that the parts of hot, cold, wet, and dry are equal, they will form the celebrated so-called moderate and ideal temperament, the ruling standard for the rest. Any temperament that diverges from this and is associated with mutually unequal powers of elements is to be called intemperate, immoderate and a nontemperament. In this unequal partnership it is absolutely inevitable that one power will surpass the others, or at most two will, but three never can. And so, since there are four from which the temperament is completely made, preeminence of one creates the four simple temperaments: hot, in which heat surpasses cold and wet and dry are equal; cold, in which cold has the upper hand; [P62] wet, whose moisture is supreme; dry, where dryness prevails over moisture, with equality between the other contraries that oppose each other. And there are four compound temperaments, which emerged into significance from the preeminence of two simple ones. For since two opposed pairs are determined by four boundaries, and both ends of one [pair] cannot prevail [at the same time], inevitably not more than two can be preminent. The same line of thought shows that although six combinations can be enumerated, only four of them can naturally exist: hot and wet, hot and dry, cold and wet, cold and dry; these are called the four compound or composite temperaments. So there are nine kinds of temperament, which ensue from the different particular sorts of mixture: one is the most moderate and occupies the mid position forged from equal parts of everything. Eight are not moderate: four simple and the same number of composite. The most moderate one is considered as indivisible and without extension, like a point. The others, which have deviated from this, extend far and wide; those we call hot are not all separated from the mean by the same interval, nor are the cold, or wet, or dry all on the same scale. In addition,

porrò euincentium qualitatum aut par est recessus, aut alias alia antecellit. Etenim calidum siccúmque appellamus, siue illa pari sunt ordine, siue calidum sicco praestat, siue contrà siccum calido. Vnde intelligitur octo cùm sint imparia temperamenta, vniuscuiusque tamen ex maiore minoréque recessu innumerabilia fieri discrimina, ex quorum proprietatibus tum similium partium, tum infinitae corporum naturae et proprietates consurgunt atque constant. Hoc praeclarè Lucretius poëmate cecinisse visus est.

- Lib. 2 *Debent nimirum non omnibus omnis prorsum*
 *Esse pari filo.*¹ Et rursum:
- Lib. 4 *Semina multimodis in rebus mista tenentur,*²
 Constituunt eadem fruges, arbusta, animantes,
- Lib. 1 *Verùm aliis alióque modo commista.*³

Si affines in permistione qualitates erunt, constans diuturnúmque temperamentum fiet: sin discordes inconstans prorsúsque mutabile. Quod mediocre definiuimus id (quia in summa rerum aequalitate, vix vlla potest aliam vincere atque dissipare) omnium diutissimè speciem suam tuetur et sustinet, ídque tum à se, tum ab externis causis minus afficitur: deinde quaecunque illi confinia et finitima sunt: quae autem ab illo abscesserunt et longiore interuallo disiuncta sunt, celerius intercidunt atque dissoluuntur. Calidum humidúmque omnium minimùm statu suo permanet (quanquam fortasse id vnum praeter caetera in plurimos annos vitam perducit) adeò vt ne constare quidem ipsum posse multi sint opinati: cùm enim assiduè nullóque puncto temporis intermisso humor vi caloris dissipetur, pro calido humidóque temperamento, breui tempore calidum simpliciter irrepet: hoc deinde in calidum siccúmque traducetur. Sub haec verò dum absumpto exhaustóque humore, calor alimento fomentóque destitutus sensim languescet, siccum absolutè succedet: ab hoc verò cùm iam calor plurimùm disiectus atque fusus extabuerit, siccum et frigidum, quod omnium verè postremum statuitur.

*Quid iustitia, quid pondere temperatum, vtrumque in rerum natura
 verè subsistere. Cap. IIII.*

SIMPLICIA QVAE diximus quatuor rerum initia, omnium quas mundus habet substantiarum extrema summè contraria tenent: horum in medio collocata sunt reliqua eorum quae gignuntur intereúntque corpora, et animalium et stirpium

among the compound temperaments the prevailing qualities deviate equally, or else one exceeds the others.

Now we call a temperament hot and dry whether these are of equal rank, or the hot prevails over the dry, or vice versa. Hence, since there are eight unequal temperaments, it can be seen that through greater or lesser deviation, innumerable varieties of each come to exist, and from their special characters the endless natures and special characters come into being, both of the similar parts and of bodies [as a whole]. Lucretius can be seen to have celebrated this notably in the poem:

Of course not all [atoms] should be of equal size.

And again:

*Mingled seeds are contained in many sorts of thing,
And fruits, bushes, animals produce them,
But mixed with other things and in another fashion.*

If the qualities in a mixture are akin, the temperament will be enduring; if they are at variance, it will be impermanent and entirely labile. What we described as the moderate preserves its form longest of all, because in the utmost equality, it is difficult for anything to overcome and disperse anything else, and it is less open to influence either from itself or from external causes. Secondly, all that closely adjoins it but has withdrawn from it and become separated by a substantial interval is more rapidly lost and disintegrated. The hot and wet maintains its place least of all (though it alone rather than the others possibly prolongs life into many years), so that many people have considered that it could not even exist. For the power of the heat vigorously disperses the wetness without missing a moment, and so hot on its own will quickly replace the hot moist temperament. This will next be converted into hot and dry; under these the moisture is spent and the heat without nutriment or fuel will gradually wane, and the dry entirely replace it. When this has made the heat mostly disperse and waste away, the dry and cold is established, which is really the last state of all.

Chapter 4. What is moderated by justice, what is moderated by mass, and that both really exist in the nature of things.

THE FOUR simple beginnings of things we mentioned occupy the utterly contrary limits of all the substances in the world. In between them lie the rest of the bodies that come into being and perish, bodies of both animals and plants

et inanimorum omnium. Quodcunque medium ad vnguem obtinebit extremorum, exacta aequalitate permistisque paribus viribus concretum, id εὔκρατον, id est temperatum appelletur: quòd ipsum et in vniuersa substantia verè ac prorsus ponderéque (vt dicere solent) medium habetur. At verò si in toto vel corporum, vel viuientium, vel animalium genere, vel in vniuscuiusque animalis specie extrema sint constituta, extra quae nihil [P63] possit illiusmodi consistere: totius comprehensae latitudinis medium quiddam mente complectemur, quod quia ab extremis illis pari abest interuallo, et εὔκρατον, id est temperatum, et σύμμετρον, id est consentaneum atque moderatum dicitur: non quidem simpliciter, sed in suo genere vel specie. Id quasi iustitiae ritu temperatum omnino est, quod generis sui decoram illam et consentaneam aequabilitatem est adeptum, qua tanquam numeris omnibus et partibus absolutum, salubriter, integrè et naturae suae congruenter se gerit, omnibúsque muniis ad quae natura sua ducitur, incorruptè fungitur. Alia autem inanimorum, alia stirpium médiocritas, alia animantium: et in animantibus, alia rursum hominis, alia leonis, alia equi, alia canis. Neque leo temperatus eodem est temperamento atque homo temperatus. Iam verò quia intemperatum id dicere mos est quod à mediocri médióque discessit, fient sanè huius vt et temperati complures differentiae. Leonem verbi gratia designare licet in specie sua frigidum, qui tamen in animalium atque in vniuersae substantiae genere, imò fortasse et alteri se frigidiori collatus, calidus sit. Hunc substantiam quidem calidam, et animal calidum, at vetò [*sic*; read “verò” with 1542] leonem frigidum esse quis rectè dixerit: aliàs simpliciter, aliàs comparatè pronuntians. Quod enim ab vniuersae substantiae medio recessit, id simpliciter intemperatum est, parem non obtinens extremorum portionem. At comparatè, vel genus generi confertur, quomodo animal calidius, stirps frigidior est: vel speciei species, sicque leo calidus, homo autem frigidus est: vel singula singulis, qua aut eodem sunt genere, aut in diuersis. Comparatè autem contraria de eodem enuntiari nihil prohibet, cùm sit homo leoni comparatus frigidus, formicae verò calidus. Tot igitur modis et temperati et intemperati notiones vsurpare consueuerunt. Quibus qui inuolutas ambiguitates non distinguunt, eos necesse est in salebras incidere operosisque nexibus implicari. Quod iustitia temperatum appellant, id omnium medicorum firmatum est consensu, qui illud in omni tum genere, tum specie inueniri non dubitant. At verò quod verè et quasi pondere temperatum intelligitur, nec haberi, nec in rerum naturae ordinem (tanquam sit repugnantia) admitti posse, contentione decertant Auicennas, Auerrhois, et quicunque in Arabum familiam se tradiderunt.

and all inanimate things. Whatever secures precisely the middle place between the limits, established with exact equality and by a mingling of equal powers, is to be called the eukraton, the temperate; it is taken as truly and completely the midpoint in the whole substance and in mass (as they usually call it). But if there are established limits in the whole kind of bodies, or of living things, or of animals, or in the form of each separate animal, outside which nothing like this [P63] can exist, we will grasp mentally a midpoint of the whole span that is encompassed; being separated from these limits by an equal interval, it will be called both eukraton (i.e., temperate) and symmetron (i.e., consistent and moderate): and not simply, but in its own kind and form. It is like justice, absolutely evenhanded, because it has achieved that honorable and consistent fairness by which, freed (so to speak) of all details and parts, it conducts itself to good effect, in integrity and in conformity to its nature, and faultlessly carries out every function to which its nature directs it. There is one mean for inanimate things, another for plants, another for animals; and among the animals, another again for man, another for the lion, another for the horse, another for the dog. A temperate lion is not of the same temperament as a temperate man. Now, because intemperate is the usual word for what departed from the mean, there will be many different sorts of it, as there are of the temperate. A lion, for instance, may be designated as cold in his own form, yet be hot among the kind of animals and of all substance, and particularly perhaps in comparison with another lion colder than himself. One might have referred to him correctly as a hot substance, and a hot animal, yet to a lion as cold, speaking in the one case without qualification and in the other comparatively. What has departed from the midpoint of universal substance is simply intemperate, lacking an equal share of the limits. But for purposes of comparison, either a kind is compared with a kind, in the sense that animal is warmer and plant colder; or else form with form, and in this sense lion is hot and man cold; or else individuals with individuals, so far as they are of the same kind, or in different kinds. For purposes of comparison there is nothing to prevent contrary statements about one and the same thing, since a man is cold compared to a lion, but hot compared to an ant. Thus people have usually employed the notions of both temperate and intemperate in so many ways, and if they fail to discern the ambiguities involved, they are bound to slip into ruts and be enmeshed in troublesome bonds. What they call tempered by evenhandedness is established by the agreement of all physicians, who are sure that it is found in every kind and form. But Avicenna, Averroes, and everyone who has attached himself to the Arab family contend that what is thought to be temperate in truth and (so

Fieri enim non posse existimant, vt ex paribus contrariorum viribus mistum quippiam emergat, quòd nulla actio, nulla ad moderationem repressio illorum concursu obtingat. Hinc Auicennae temperamentum (qualitas nimirum quinta ex elementorum confusione recens nata) fieri nullum potest vsquequaque et sine vlla exceptione medium, sed id necesse est in extremorum aliquod esse propensius. Caeterùm multò aliter res habet. Nam si elementorum summae qualitates vt et substantiae in permistione non pereunt, sed asseruatae temperamentum constituunt: nihil prohibet aequis illas portionibus mistas, exquisitè temperatum proferre, quod in proportionis situm est aequabilitate. Licet enim in illa aequabilitate non tanta sit mutua qualitatum actio, quae vel abolitionem vel repressionem contrariorum molietur: tanta tamen est vt paria contraria possit confundere ac verè permiscere in vnum temperamentum: minus enim virium et inaequalitatis contrariorum temperatio desiderat, quàm illorum dissolutio atque occasus. Ergo perfectè et aequo pondere temperatum in natura rerum haberi, tum per haec palàm fit et apertum, tum etiam quòd dum ex frigido humidòque temperamento in calidum siccúmque quiddam abit, necesse est per hanc deduci mediocritatem. Ea autem vbinam et quomodo subsistat, in conspectu atque oculis omnium mox erit, vt internoscendi temperamenti summam rationem attigero.

*Hominis tactum, discernendi temperamenti
legem esse et iudicem. Cap.V.*

QUISQUIS COMPOSITI corporis temperamentum ex insertis elementorum portionibus aestimare volet, cognitionem multis obstructam difficultatibus et à rebus obscuris petitam suscipiet: occultae enim sunt et penitus abditae simplicium vires, adeò vt iudicij nostri infirmitas, quanta sit cuiusque in concretis portio, inuenire se posse diffidat. Horum igitur si quid certum reddi potest, id non nisi sensuum beneficio comparandum, per quos [P64] rerum in animis imprimuntur. Quicquid enim animo cernimus, id omne originem traxit à sensibus. Quemadmodum colores internoscimus consuetudine oculorum, et de odoribus iudicaturi olfactui fidem habemus, sic opinor et de principibus qualitibus quae sub tactum recidunt, non est tactui fides abroganda, sed cuique sensui de his quae perceperit et de propria obiecta re iudicatu, tanquam exploratori et vero nuncio credendum. Siquis fortè sprete fideli

to speak) by mass does not exist, and cannot be admitted into the natural order of things, as if there were an antipathy. They think it impossible that anything mixed should emerge from equal powers of contraries, because no activity, no reversion to moderation befalls their association. Hence Avicenna's temperament, evidently a fifth quality newly born from the mixing of elements, cannot be any midpoint in every respect and without exception, but must be biased toward one of the limits. However, the fact is quite different. For if the highest qualities and also the substances of the elements do not perish in mixing, but persist and make a temperament, there is nothing to prevent them, when mixed in equal parts, producing with precision a temperament placed in equality of proportion. It may be that in that equality there is not such an interaction of qualities as to produce abolition or reduction of contraries; but there is enough to mingle equal contraries and genuinely mix them into a single temperament. For making a temperament requires less of the powers and inequality of contraries than their dispersal and extinction does. It becomes clearly evident from this that perfect tempering with an equal mass exists in the nature of things, and evident too because when something departs from a cold and wet temperament into a hot and dry one, it cannot fail to traverse this midpoint. Where and how the midpoint exists will soon be before everyone's eyes, when I reach the final explanation of how to distinguish a temperament.

Chapter 5. Human touch is the decisive assessor for distinguishing temperament.

ANYONE WHO wishes to estimate the temperament of a composite body from the proportions of elements in it will embark on an inquiry set about with many difficulties and a prey to obscurities. The powers of the simple things are so deeply concealed that our weak judgment doubts its ability to discover how much of each there is in composites ["concretis"]. If any reliable account can be given about composites, it can only be done thanks to the senses, through which the notions [P64] of things are imprinted on minds. Whatever we perceive in our mind drew its whole origin from the senses. Just as we distinguish colors by the habitual use of our eyes, and when setting about judgments about odors we trust our sense of smell, similarly too in the case of the principal qualities that fall under the sense of touch, trust should not be withheld from that sense, but we should rely on every sense that is going to pass judgment on what it has perceived and on what is properly before it, as a scout and trustworthy messenger. Anyone who happens to disregard the faithful

sensuum constantia et autoritate, omnium quae obiectantur demonstrationes requirit, quibus olorem album esse, coruum nigrum, ignem calidum, glaciem frigidam sibi persuadeat, is profectò desperata cognitione certi, omnia in suspicionem et ignorantiam trahet.

Lucret. Lib. 1

*Quid referemus enim quod nobis certius ipsis
Sensibus esse potest, quo vera ac falsa notemus?*⁴

Sublatis sensibus, qui quasi fundamenta quaedam sunt scientiarum, nihil iam quicquam relinquetur, vnde sumi possit demonstrationis exordium.

dem eodem libro

*Inuenies primis ab sensibus esse creatam
Notitiam veri, neque sensus posse refelli.*⁵

Idem lib. 4

*Qui nisi sint veri, ratio quoque falsa fit omnis.*⁶

Cùm igitur sint illorum iudicia tanquam communes animi notiones Geometris appellatae, si quid illis ad demonstrationem praeponetur, iam omnis doctrinae ratio in confusam perturbationem acta concidet, atque ex posterioribus superiora necessariò connectentur. Ergo quod ἐνεργεία, id est re ipsa, aut quod dicere solent actu, calidum, frigidum, humidum, siccúmve est, id tactu liceat internoscere, non leonis quidem aut equi aut canis, sed solius hominis tactu, qui tum dignitate tum temperamenti mediocritate caeteris antecellit. Qui enim cani aut asino potius quàm homini animantium prudentissimo ac sapientissimo, discernendi scientiam defert, praeterquam quòd ridiculus habetur, rerum cognitionem nobis adimit, asinis verò largitur, à quibus nunquam possumus erudiri. An (vt inquit Tullius) dum bestiae loquantur expectamus, hominum consentiente auctoritate contenti non sumus? Ne quis igitur angustos sensus nostros reddat, aut nos omni rerum cognitione priuet, hominis prudentiae praestantíque naturae tactus temperiem commitemus, quae reliquorum omnium lex sit et regula. Atque eius potissimum hominis qui optimi sit habitus, quíque omnium iudicio temperatus, si non omnino, at certè quasi iustitia quadam censeatur. Is itaque quod omnium quae sub sensum veniunt calidissimum est, velut ignem aut aquam quae ad summum ferueat, calidissimum quoque decernet: niuem aut glaciem frigidissimam: et quod paribus illorum modis dimensionibúsque perfusum componetur, id vt in medio extremorum situm, sic in calore et frigore temperatum pronuntiabit, neque si manum in id demittat, inde quicquam afficietur aut sentiet. Rursum terram vel cinerem, vel tale quippiam quod planè sit aridum, si pari aquae modo conspergatur, vt humidi siccíque verè medium obtineat, id demum tangens atque tractans neque durum neque molle sensu percipiet. Vnde intelligitur hominis vtcunque temperati tactum illis esse persimilem, esseque hunc verè medium omnis exuperantiae, calidi, frigidi, humidi, et sicci. Is autem

regular guidance of the senses, and demands proof of everything they encounter to convince him that a swan is white, a crow black, fire hot, and ice cold, will certainly despair of learning anything sure, and will take everything as suspect and unknown.

To what shall we refer that can be more reliable to us than our senses themselves, by which we may identify truth and falsehood?

Without the senses, which are so to speak the foundation of knowledge, nothing at all will now remain from which proof can take off.

You will find that the knowledge of truth was created from the primary senses, and they cannot be refuted; unless they are truthful, the whole of reason is in error.

Their judgments are like what geometers call the general notions of the mind, and if anything is thought superior to them as evidence, the whole basis of teaching is thrown into confusion and will collapse, and what comes earlier will be derived necessarily from what comes later. So let what is hot, cold, wet or dry in “energia,” that is, in reality or (as they say) in activity, be identified by touch, and not by the touch of a lion or a horse or a dog, but by human touch alone, which excels the others in status and in the moderateness of its temperament. Anyone who delegates discrimination to a dog or a donkey rather than to a man, the wisest of animals, is treated as absurd, and furthermore deprives us of the knowledge of things and bestows it on donkeys, that can never give us enlightenment. As Cicero puts it: are we dissatisfied with the unanimous authority of humanity, and waiting for the beasts to speak? So in case anyone narrows down our senses, or robs us of all knowledge of things, let us entrust temperament to the wisdom of man and to the exceptional nature of touch, since it is the standard governing all the rest. The particular man should be in excellent condition, and be regarded as completely moderate by everyone, or if not completely, then at least on a fair assessment. The hottest thing of all that come before the senses, whether fire, or water boiling right up, he will therefore specify as hottest; snow or ice as coldest [translating as “frigidissimum”]; what has a composition pervaded with equal measures of these, thus lying midway between the limits, he will adjudge as temperate in heat and cold, and if he puts his hand in it, he will feel no effect from it. Again, if earth or ash or something of that kind that is obviously dry is sprinkled with an equal amount of water, so as to occupy a true midpoint of wet and dry, on proceeding to touch or handle it he will sense neither hard nor soft. Thence it is deduced that a man’s sense of touch, provided he is temperate, is very like those [midpoints], and this is the true midpoint between every extreme: hot, cold, wet, and dry. This sense of

cùm per totam cutem aequabiliter fusus sit, quae rerum externarum appulsus sentiat, palàm fit hanc quoque omnium extremorum verè mediam haberi, et omnis superlationis expertem, eam praesertim quae manum integit, maximèque summos digitos. Quocirca huic rectè internoscendorum temperamentorum aequa aestimatio regulàque cognitionis et iudicij defertur, si modò ab his quae extrinsecus occurrunt, vt à calore, vt à frigore nihilo sit conuersa, neque vllam commutationem acceperit, neque vti fossoribus callo sit obducta. Quae enim sic affecta erit, improba et iniqua aestimatione in errorem inducet: ita quidem monente Lucretio.

Lib. 4

*Denique vt in fabrica si praua est regula prima,
Normaque si fallax rectis regionibus exit,
Omnia mendosè fieri atque obstipa necessum est:
Praua, cubantia, prona, supina, atque absona recta,
Prodit a iudiciis fallacibus omnia primis.⁷*

[P65] Quocirca in iudicium et tactus aestimationem cutis adhibenda est, quae talis omnino perstiterit, qualem natura eam conformauit: nam et mox erit manifestius ex sua illam compositione temperiem accepisse.

De singularum partium corporis humani temperatura. Cap. VI.

VT PRIMÙM tactus aestimatione, sic rursum substantia et compositione, partium corporis humani temperamenta noscuntur. Sanguis totus natura calidus est, ex hoc caro tota fermè condita est, quae idcirco compositionis partium tanquam lex quaedam nobis esse potest. Cernuntur et in nobis quaedam vsque eò frigida, vt nemo ea possit in dubium et controuersiam adducere, quod genus sunt ossa, cartilagine, et exanguia omnia: quae tanto sunt frigidiora quanto minus sanguinis et carnis adepta sunt. Inter vtraque planè medium quiddam est cutis, ex ambobus aequè permixtis constituta, tanquam sanguine et carne praeditus neruus. Constat enim ex carne molli, et neruo duro: ac proinde duri mollisque, et humidi sicque medium occupauit. Quò fit vt ab vtriusque oppositionis extremis pari interuallo seiuncta, aequis eorum portionibus temperetur, neque iis quidem compositis modò, verumetiam per totas commixtis. Quocirca vt sensus iudicio, sic et fabrica compactioneque, cutis videtur media temperie contineri. Reliquarum autem similium temperamenta sic illius comparatione dimetimur.

touch is spread evenly over the whole skin, to detect the impacts of external things, and so it becomes obvious that skin is truly in the middle of all the extremes, and is free from all bias, especially the skin over the hand, and above all the fingertips. Consequently to it is entrusted the just judgment to distinguish temperaments, and the standard of knowledge and decision, provided only that it has been unaffected by outside influences such as heat and cold, and undergone no alteration, nor been indurated as occurs in miners. Skin thus impaired will lead to error from unsound and biased assessment; as Lucretius warns:

Finally, as happens in construction if the master ruler is crooked, and if a deceptive square departs from the right lines, everything must needs be made faultily and awry: uprights are crooked, sagging, tilted forward or backward, and askew; all is betrayed by deceptive decisions at the start.

[P65] Consequently, for decision and the assessment of touch the skin is to be used, which will have remained entirely as nature shaped it; that it has received the tempering already mentioned from its own composition will soon become clearer.

Chapter 6. The tempering of individual parts of the human body.

JUST AS the temperaments of the parts of the human body are recognized initially by assessment through touch, so they are recognized again by substance and composition. All the blood is hot by nature; from it practically all the flesh is made, which consequently can be (so to speak) our standard for the composition of the parts. Some parts can be made out in us so cold that no one can raise doubt or argument about them; this kind are bones, cartilages, and all the bloodless parts; the less blood and flesh they possess, the colder they are. Skin is clearly a midpoint between the two [hot and cold], made up from both equally mixed, just as nerve is endowed with blood and flesh. It is made from soft flesh and hard nerve; accordingly, it took up the midpoint between hard and soft and between wet and dry. Thus it comes about that it is separated by an equal interval from the limits of each pair, and tempered from equal parts of them, parts not just assembled but mixed throughout the whole. Therefore skin is seen to consist of a medium temperament, both on the evidence of the senses and from its structure. We measure the temperaments of the rest of the similar parts thus by comparison with skin.

Spiritus omnium quae in corpore sunt calidissimus, hoc ipso cor minus calidum, deinde sanguis, post hunc caro simplex: hanc sequitur iecur, hoc lien, lienem renes, cutis his succedit temperata. Ab hac in frigidum propensus est adeps, deinde cerebrum: hoc frigidior spinae medulla, hac frigidiores sunt nerui molles, deinde sequuntur duriores motibus accommodati, ab his est vena, deinceps arteria, post hanc membrana, his omnibus frigidior est tendo, hoc rursum frigidius vinculum, chondrosyndesmos proximus est: deinde cartilago, os ei finitimum: ab hoc pilus est, vltimo loco pituita omnium quae in corpore sunt frigidissima. Quae alterius oppositionis sunt qualitates, illis à natura hoc modo sunt inditae. Pilus omnium est siccissimus: hunc suo quaeque ordine deinceps consequuntur, os, cartilago, chondrosyndesmos, vinculum, tendo, membrana, arteria, vena, neruus motui destinatus. Ab his cutis succedit temperata. Hinc in humidum iam abit ueruus [*sic*; corrected to “neruus” in Errata at end of the volume] sensui designatus: cor hoc ipso iam est humidius: deinde sunt renes, iecur, lien, caro simplex. His succedit pulmo, post hunc est spinae medulla, dein cerebrum, mox ossium medulla, adeps proximè illi est, subsequitur sanguis, postremò pituita omnium quae in nobis sunt, vt frigidissima ita humidissima. Haec posterior humidorum siccorumque series tactus iudicio confirmata est, cui et substantiae compositio prorsus consentit. Cùm enim in nobis dum viuimus non summa sit vis frigoris, per quam valeat quicquam in duritiam concreescere, neque extremus is calor insit, qui concreta liquare possit: quicquid tactu molle deprehendetur, id quoque humidum: quicquid durum, id statim siccum censeatur. Sic igitur dum in nobis vigeat moderatus vitae calor, humidi siccique tactus erit aequus aestimator et arbiter. Caeterum altera oppositione qua ad veterum imitationem partium temperamenta digessimus, neque tactu omnia, neque substantiae compositione, sed nunc hoc nunc illo, aliàs vtroque modo singula dimetimur. Cor solo tactu definitum est calidissimum, quòd dissecto animantis pectore, digitisque in sinistrum cordis sinum immissis, sentiatur hic locus omnium qui in animali sunt calidissimus. At si substantia spectetur, cor simplici carne frigidius existet. Venae et arteriae quia spiritus et sanguinis contagione incalescunt, possent perinde atque cor calidae censi: caeterum ex compositione quia exangues sunt, inter frigidas habentur. Porrò autem pulmonis siue compositionem, siue calidum biliosumque nutrimentum, siue cordis vicinitatem et adhaesionem respicies, illum sanè iecore tum calidiorem tum multò sicciorum iudicabis. Quid igitur Galeno in mentem venit vt humidum hunc statuatur, nisi fortasse ab inducto aëre frigido et ab irruente defluxione, atque omnino ab excrementis illi temperamenti rationem indidit? Adeps concretione frigidus censetur, cuius tamen substantia ad inflammationem apta et habilis calorem significat. Cerebrum substan-[P66] tiae compositione

Spirit is the hottest of all that is in the body, the heart is less hot, next is blood, after it simple flesh; liver follows, then spleen, then kidneys; skin with its temperament comes after them. After it, fat tends to coldness, then brain; spinal cord is colder, the soft nerves are colder than it, next come the harder nerves adapted to movements, after them vein, artery follows; next is membrane; tendon is colder than all these, ligament is colder still, cartilaginous ligament is next. Then cartilage; bone is close to it; hair follows; phlegm is the coldest of the things in the body. The qualities of the other opposed pair are attached to these by nature in the following way: hair is the driest; then follow in their succession bone, cartilage, cartilaginous ligament, ligament, tendon, membrane, artery, vein, nerve devoted to movement. After them follows temperate skin. From here nerve devoted to sensation moves off to the wet side; heart is the next wetter; after come kidneys, liver, spleen, simple flesh. Lung is next, and after it spinal cord, then brain; next is bone marrow; fat is close behind, blood follows, finally phlegm, which is both coldest and wettest in us.

This later series of wet and dry is established by the judgment of touch, and the composition of substance is in complete agreement. For during life the highest power of cold, enabling anything to solidify hard, is not present in us, nor is heat extreme enough to melt solid things. Anything found soft by touch is wet too; anything hard is at once to be reckoned dry. Thus, as long as a moderate vital heat flourishes in us, touch will be an impartial judge of wet and dry. But in [relation to] the other pair of opposites, by which (following the ancients) we classified the temperaments of the parts, we do not measure everything by touch, nor by composition of substance, but we measure individual cases now by one and now by the other, and at other times by both. By touch on its own the heart is specified as very hot, because in the dissected animal's chest this part feels the hottest of all in the animal, when the fingers are put into the left chamber of the heart. But if substance is the criterion, the heart will turn out colder than simple flesh. Veins and arteries grow warm because they are in contact with spirit and blood, and so could be reckoned hot like the heart; but since they are bloodless by composition, they fall among the cold parts. Again, whether you consider the lung's composition, or its hot and bilious nutriment, or its close attachment to the heart, you will certainly judge it hotter and much drier than liver. So what possessed Galen to regard it as wet, unless perhaps he applied a basis for its temperament from the entry of cold air and the inrush of a defluxion, and in a general way from the waste substances? Fat is reckoned cold from its congealing, but the inclination of its substance to inflammation indicates heat. Aristotle recorded that [P66] brain was very cold

Aristoteles frigidissimum prodidit: hoc Galenus tactum iudicem cùm adhibuerit, cùmque à circumfuso quouis aëre refrigeratum laedi cognouerit, calidum esse contendit. Itaque de partium temperaturis non nisi distinctione adhibita quicquam certò licet pronuntiare.

De vniuersi hominis temperamento, neque viuens omne calidum esse. Cap. VII.

DISSIMILIIUM PARTIUM atque totius animantis temperamentum, ex similium compositione, imitatione quadam exprimimus. Nam os, neruus, aliáque similia suis substantiis integra manent in nobis, neque similiter atque elementa in confusionem adiguntur, qua sese vicissim conuertant. Ab his tamen singulis calidis frigidisque, par est tum humores quosdam atque vapores, tum verò et spiritus communiter in omne corpus erumpere, qui deinde variis praediti qualitatibus variisque temperamentis, in vnum commeantes atque confusi, sese demum temperent, fiátque ceu vnum totius temperamentum, non illud quidem simplex, sed ex multorum concursione conditum. Hinc eorum error planè coarguitur qui simplicem qualitatem id esse proponunt, cùm apertum et perspicuum sit, similem quamque partem proprium et ingenitum retinere temperamentum, neque ex mutatis illis simplex vnum totius effici. Ea communione euecti tum vapores tum spiritus, in corporis extima in ipsámque cutem cenfluunt [*sic*; read “confluunt” with 1542], eámque sic afficiunt, vt hac moderatione praedita, eo prorsus sit temperamento quo et vniuersum corpus: si quidem ab his quae extrinsecus imminet causis, aduentitiam illa constitutionem nullam acceperit. Quo fit vt solius cutis contactu licet de vniuersi corporis temperamento pronuntiare. Quemadmodum igitur antè demonstratum est cutem vniuersae substantiae medium obtinere, sic fiet puto ex his manifestum atque promptum, hominem qui iustitia sit temperatus (quales plerique passim visuntur) eundem quasi pondere et in vniuersa substantia temperatum inueniri. Huc accedit, quòd singulae partium temperaturae seorsum aestimatae, in commune relatae si comparentur, calidae frigidis, et humidae siccis, omnium quaedam aequabilitas accersetur, et cognoscetur homo partium suarum compensatione temperatus. Tales plerunque sensus comprehendit exili quadam latitudine à medio disiectos: nam exquisitè et ad vnguem temperatus, vt in indiuiduo quodam ceu puncto diutiùs consistere non potest, sic quasi regulam et caeterorum exemplar illum cogitatione quàm re potiùs complectimur atque informamus. Palàm est autem alios quosdam ab hoc deficere, alios superiores esse, et hi

from the composition of its substance; Galen, having used touch as the criterion and recognized that brain is damaged by chilling from any air around it, maintained it was hot. And so a reliable verdict about the temperaments of parts can only be reached with discrimination.

Chapter 7. The temperament of a man as a whole, and that not everything living is hot.

WE USE the example of the composition of the similar parts to describe the temperament of the dissimilar parts and of the whole living creature. For bone, nerve, and the other similar parts persist in us unimpaired in their substances, and do not enter as elements do into combination, in which they may transform each other. But out of these individual hot and cold things, it is reasonable that some humors and vapors, and indeed spirits too, burst out into the whole body generally, and then with their various qualities and temperaments they assemble and are combined into one, they go on to temper each other, and there develops (so to speak) one temperament of the whole, and not a simple one, but one made from the assembling of many. This shows up clearly the mistake of those who describe it as a simple quality, although it is obvious that each similar part keeps its own inborn temperament, and they are not changed to make one simple one of everything. Both the vapors and the spirits that arise from this combining gather in the outside of the body and the skin itself, and work on it in such a way that, thus moderated, it is of absolutely the same temperament as the whole body. But if [it is worked upon] by causes that impinge from outside, it will not adopt any external organization. Thus it becomes possible to give judgment on the temperament of the whole body from contact with the skin alone. So, just as it was shown earlier that skin occupies a midpoint of all substance together, thus I think it will become manifest from this that a man who is justly tempered (as most men everywhere are seen to be) turns out tempered both in mass and in his whole substance. There is this too, that if the individual temperaments of parts, assessed separately, are brought together and compared (the hot temperaments with the cold, and the wet with the dry), an even level of all will be introduced, and a man will be recognized as tempered by the balancing of his parts. As a rule our senses [singular] identify such men as displaced some small deviation from the mean; the precisely tempered man, unable to balance long on (so to speak) some single point, is appreciated by us more in imagination than in fact, as a standard and pattern for the rest. It is common knowledge that some fall short of this, others rise above it; and the

verbi gratia calidi sint, illi frigidi: idcirco neque viuens omne dominatu calidum haberi. Caeterum quò haec illustriora clarioraque euadant, incudi illa reddere et iterum tundere consilium est. Quod enim explicatum à nobis est hominis temperamentum, ex partium omnium prima commodatione, et ex spiritus tum vagi tum fixi affusione, id componi tenerique sentiendum. Quandoquidem propria cuiusque partis temperatura quam quatuor elementorum permistio tulit, non alia inest viuenti atque animali iam primum extincto. Si enim derепente id suffocatum de vita decessit, corporis partibus quae superant non sic puncto temporis sua potuerunt temperamenta perire, neque fieri potuit vt quaedam elementa tam subito euanescerent aliis recens genitis, nouaque proportio illis accederet nondum mutua affectione commutatis. Quocirca vt demortui ita vitam agentis vnaquaeque particula frigida videtur, atque si ea quae ex primorum elementorum comparatione est temperatura spectabitur, plus terrae quàm caeterorum obtinere. Vnde intelligitur viuentis eum calorem qui per corpus diffusus omnia regit ac moderatur, et cuius appulsu vita inest, cuius excessu mors irruit, à partium temperamentis differre, neque ab his proficisci. Sic propemodum et stirpibus suum quendam inesse calorem, cuius ope alantur, increscant, atque generent: quo demum pereunte omnis quoque naturae actio intermoritur: licet quae tum supersunt, folium, lignum, cortex, vt vetus nomen sic suum ex elementis temperamentum retineant. Calorem hunc in cunctis viuentibus tum animantibus, tum stirpibus non solum inesse, verumetiam principatum [P67] tenere, celeberrimi quique philosophi prodiderunt. Cùm enim omnis ab illo naturae sit actio, calidum vincere, et in actionibus superare pronuntiant: neque modò formicam aut salamandram, sed et papauer quoque et mandragoram, quòd non nisi eccellente calore et nutriantur et increscant, calida constituunt. Quem in modum confirmauit Aristoteles omne animal natura calidum humidumque esse, qualis vita quoque ipsa censetur: demortuum verò, frigidum siccumque: singula sic sensus iudicio fuisse comprobata. Iam verò quod in praesentia scrutamur corporis temperamentum, neque hoc, neque illud est, sed ex vtroque quodammodo complexum tenetur. Neque enim solum vitae calorem qui functionum opifex est spectamus, vt ab hoc viuens omne, calidum iudicetur: neque solum primam illam et verè materiata ex elementis concretionem, qua vnumquodque frigidum est: sed id proprium perfectumque temperamentum est, quod ex prima elementorum confusione et ex feruido calentique spiritu integratur. Hoc itaque totius est corporis, vno tactu internoscendum: quo iudice

latter, for instance, may be hot, the former cold. Hence not every living thing is reckoned hot by virtue of its predominance. But it is advisable to place these [topics] on the anvil and strike them repeatedly to make them more lucid and clear. The temperament of man, as we have explained it, is to be regarded as made up and maintained from the original adjustment of all the parts, and from the pouring on of spirit both wandering and fixed. For the particular temperament of each part provided by the mixture of the four elements is just the one embodied in the living and the recently dead animal. For if it has died of sudden suffocation, the parts that still survive cannot have their temperaments destroyed in a moment, nor could some elements vanish so suddenly when others have just been brought into existence, nor a new balance appear for them when they have not yet been converted by their mutual relations. Consequently, each small part, of a dead creature as of a live one, seems cold, and if the temperament is viewed in relation to that of the original elements, it possesses more earth than it does of the rest. Hence it is evident that the heat of the living creature, diffused throughout the body and in control of everything, by whose influence life is present, through whose departure death intrudes, is not the same as the temperaments of the parts, and does not stem from them. In almost the same way plants have an internal heat of their own, thanks to which they are nourished, grow, and multiply; when it reaches its end, all nature's activity dies off too, although the persisting foliage, wood, and bark retain both their old name and their temperament from their elements. All the most distinguished philosophers have held that this heat is not just present in all living animals and plants, but also [P67] holds the leading place. Since all nature's activity depends on it, they declare that heat prevails, and surpasses in its actions; hot constituents make up not only the ant and salamander, but also the poppy and mandragora, as to be nourished and grow they need the supremacy of heat. In this context Aristotle asserted that every animal is hot and wet by nature (and life itself too is regarded as the same), but that corpse is cold and dry; in this way [according to Aristotle] individual things were evaluated by sensory decision. However, the body's temperament that we are considering at the moment is neither one nor the other [presumably neither completely hot nor completely wet], but somehow includes both. We are not considering just the vital heat that crafts the functions, causing every living thing to be regarded as hot, nor just that original coalescence genuinely made into material out of the elements, by which everything is cold. The particular perfect temperament is the one completed from the original intermingling of the elements and from boiling hot spirit. It is a feature of the whole body, recognized by touch alone; with touch

stirpes omnes re ipsa et actu frigidas censebimus, animantes verò alias tota specie calidas, alias frigidas, humanam speciem omnium mediam, in qua hic calidus, ille frigidus est: alius mediocritatem tenet ceu lex quaedam caeterorum. Hic siquidem in extremorum medio positus, ex paribus constat portionibus, terrae, aquae, aëris et ignis: si modò aëris ignisque appellatione non solùm ea quae verè sunt elementa, sed et genuinus spiritus et aethereus ille noster calor comprehenditur, quomodo à praeclaris tum philosophis, tum medicis fieri animaduertimus: dum censent animam am [*sic*; Errata at end of the volume indicate deletion of this interpolation] à corpore seiungi non posse, quin simul naturali sua temperie corpus deseratur.

*Vt tactus non simpliciter partium interiorum temperamenta
discernat. Cap. VIII.*

AD INTEGRORUM imitationem si partium interiorum temperamenta paulò altius exquirimus, fient singulae concretionem frigidae, accedente autem spiritu et calore qui vitae comes est, calidae: amborum comparatione, aliae calidae, aliae frigidae, quaedam vt cutis temperatae. At verò (dicet aliquis) viuentis interiora si contingere dabitur, quaecunque pars adest, seu cerebrum, seu os pituitave sit, eam sine controuersia tactus calidam cognoscet. Quocirca ille si aestimator est interiorum partium constitutus, omnes promiscuè calidas censuerit. Et reuera nihil intus cohiberi experimur, quod tangente sit cute frigidius. Sed huic disceptationi obsistendum est, et quaestionis obscurae solutio nobis peruestiganda. Omnes quidem intus partes tangenti calidae sentiuntur, neque tamen temperiem singulae calidam adeptae sunt, quòd is calor non insitus illis sit, sed assumptus magna ex parte et aduentitius. Illis enim praeter primam ex elementis temperiem, et praeter spiritus calorem, à quibus integrum fieri diximus viuentis particulae temperamentum, alius quoque calor ex cordis vicinitate et ex vaporibus accedit, ei quadam similitudine respondens, qui nobis ex igni aut ex meracioris vini potione accersitur. Quoniam verò hic partium substantiam non complet, in temperamenti notione nequaquam comprehenditur: caeteroquin cordis vinculum et capsula, quae tota est membranosa calidiori sit temperie, quàm pedis aut tibiae caro. His rebus adductus vix fieri posse statuo, vt de proprio interiorum partium temperamento solus tactus decernat, quippe cui syncerum illud et purum non occurrit, sed multo perfusum externo calore. Iudex

for our judge, we will assess all plants as in fact and activity cold, but some animals as hot in their whole form, others cold, with the human form the central one of all, in which one person is hot and another cold, while another is in the middle and a standard (as it were) for the rest. If he is at the midpoint between the ends [of the scales], he comprises equal parts of earth, water, air, and fire, provided that not just the true elements, but also genuine spirit and that ethereal heat of ours are covered by the words air and fire, as we have seen done by notable philosophers and physicians. They consider too that the soul cannot be separated from the body unless the body relinquishes its natural temperament at the same time.

Chapter 8. Touch does not straightforwardly discover the temperaments of internal parts.

IF WE look a little more deeply into the temperaments of the internal parts, so as to reproduce whole bodies, individual parts will become cold from [their formation by] coalescence, but hot when the spirit and the heat accompanying life are added. From the comparison of the two, some parts are hot, some cold, and some (like skin) moderate. "Ah, but," someone will say, "if it becomes possible to touch the insides of a living creature, touch will undoubtedly recognize any part it reaches as hot, whether it is brain, or bone or phlegm." So if touch is the established judge of the inside parts, it will assess them all as hot regardless. And in fact we do not find any of the internal contents is colder to touch than skin. But we should resist this judgment, and inquire into the answer to a puzzling question. All the inside parts feel hot to touch, yet none have acquired a hot temperament, because this heat is not implanted in them [i.e., not "innate heat"], but largely acquired from outside. For to their original temperament of elements and the heat of spirit, from which we said that the complete temperament of the living part arises, there is added another heat from the neighborhood of the heart and from vapors, bearing some resemblance to the heat we derive from a fire, or from drinking wine with not much water. Since this heat does not occupy the substance of the parts, it is not included at all in the idea of a temperament; if it were, the sheath confining the heart, which is entirely membranous, would be of a hotter temperament than the flesh of foot or shin. In the light of these points I regard it as barely possible for touch alone to be the arbiter of the special temperament of the inside parts, since the temperament that meets touch is not pure and simple, but overspread with much heat from outside. Touch, however, could be a good judge only on

tamen bonus is esse possit vnà cum ratione, quae substantiam atque structuram explorabit. Solus verò satis est de totius integritque corporis, cùm reliquorum animantium tum hominis, ex aequo et bono iudicium facere, atque his potissimùm videtur accommodatus.

Multis ex causis ingenitum temperamentum mutari, quâque id ratione accidat. Cap. IX.

HUMANUM CORPUS patibile cùm sit et affectioni subditum, ab aduersis causis siue praegressae illae sint siue antecedentes, siue proximae et continentes, multa solet perpeti atque sustinere. Sic enim plerunque à cibo pleniore, à vini potione, ab aestu, à balneis, ab exercitatione incalescit vehementiùs, quemadmodum contrariis ex causis refrigeratur. Quaecunque ab illis inducta corpori fuerit affectio, per summa illius diffunditur et inhaeret, [P68] mutabilis et inconstans, adeò vt si per se et solitariae suae naturae id relinquatur, leuissimè transfuga à seipsa desciscat, et tota quammoxtanquam adscita et aduentitia exolescat. Itaque quoniam hac euanescente corpus ad se pristinâque constitutionem redit, temperamentum autem constans est et firma corporis habitudo, constat illam temperamenti speciem minimè permutare. Caeterùm si fortè illarum efficientium causarum assiduus sit appulsus, nullôque puncto temporis intermissa adhaesio, fieri quidem contingit vt tum demum temperamentum, ipsâque elementorum proportio commutetur: quod hac ferè ratione obuenit. Primùm vi causarum, qui in corpore diuagatur spiritus, aut aër diffusus in caecos et abditos recessus, incalescit, si quidem causae erant caloris effectrices: hinc in humores et teneram corporis substantiam sensim calor prorepat, tum demum solidiorem molem occupat. Pergente autem causarum impetu, necesse est singulas ordine suo exiguas frigidorum elementorum portiones obteri, et à pristina constitutione in contrariam calidiorémque facessere. Hae quandiu sic mutatae suam adhuc speciem retinent, temperamentum etiânum manet nihil mutatum: adscitus enim duntaxat et arreptitius is calor est. At verò cùm diuturnitate fiet imbecilliorum partium (non enim omnes aduersis aequè obsistunt) tanta decessio, vt frigidorum elementorum plures portiones et fragmenta pereuntibus formis in calidorum naturam contendant; tum primùm toti immigrat temperamenti mutatio. Summotis verò tum causis, cùm corpus non vltrâ illarum vi pulsabitur, quaecunque partes supra modum incaluerant nondum tamen formis suis spoliatae, ad superiorem temperamenti modum sponte sua recurrent: calidae verò hae quidem permanebunt quarum iam species exoleuit. Quoniam igitur per illas

the basis that it will ascertain substance and structure. It is enough on its own to form a well-poised judgment about the temperament of the whole intact body [supplying “temperamento”], both of the other animals and of man, and it appears particularly suited to these.

Chapter 9. The inborn temperament is altered by many causes,
and the basis on which this occurs.

SINCE THE human body is capable of being acted upon, and open to influence from adverse causes, either over and past, or antecedent, or recent and continuous, it commonly endures much. Thus it is generally heated quite strongly by liberal eating, by drinking wine, by summer heat, by baths, by exercise, and similarly cooled by the opposite causes. Any effect these produce on the body spreads over its surfaces and attaches itself, but so [P68] unreliably that if the body is left to itself and its own nature alone, the effect slips away very nimbly on its own, and all fades quickly, being imported from outside. And so with its departure the body reverts to itself and its previous condition, but the temperament is unchanged and the bodily state steady; there is agreement that it alters the kind of the temperament very little.

But if the impact of these efficient causes is persistent and their attachment is unbroken even for a moment, in the end a change in the temperament and in the balance itself of the elements comes about. This usually develops on the following basis. First, the power of the causes (provided they are effective causes of heat) warms the spirit that wanders in the body, or air penetrating into remote dark recesses. Then the heat steals gradually into the humors and the soft substance of the body, and in the end enters the solid bulk. As the impact of the causes proceeds, inevitably individual small portions of cold elements are destroyed in their sequence, and depart from their original constitution into an opposite and hotter one. Though changed in this way, as long as they still retain their form [“speciem”] the temperament still remains unaltered, because the heat is merely imported. But with the passage of time there will be so much retreat of the weaker parts (not all parts resist equally) that more parts and fragments of the cold elements will make for the nature of hot ones as their forms vanish. Then a change of the complete temperament moves in for the first time. But after removal of the causes, when the body no longer pulsates from their power, all the parts that had been overheated when still in possession of their forms will spontaneously revert to the previous type of temperament, and the hot parts whose form has now matured will persist. Since they have

firmus et stabilis toti calor accessit, erit pro earum multitudine aucta caloris proportio, aliúdq̃ue inuectum temperamentum. Quemadmodum autem ab iis causis quae foris sunt, ita multò promptiùs et procliuiùs ab esculentorum potulentorúmque longo vsu, si quidem illa immoderato erunt calore, corporis temperamentum in calidius traducetur. Huic obiter subtilior solertiórque meditatio succedit. Cùm enim corpus humanum ex variis sit particulis constitutum, aliis quidem mollioribus, vt carne, vt nervo, aliis solidioribus vt membrana, cartilagine, osse: quaecunque harum magis patibiles sunt, primae à sua com-
 moderatione decedunt: solidae verò non nisi longo tempore et ingenti causarum incursione, è statu deiici et deturbari possunt. Quinimò cùm sint illae fibris quibusdam firmissimis intextae, quibus plurimum inest firmamenti et roboris, sic illas duco aut nunquam vlla vi labefactari posse, aut tenuiter vsqueadeo et parcè, vix vt toto aeuo insigne quicquam perpeti possint. Itaque quorundam ego iudicium sequutus, insitum illud et primarium corporis cuiusque temperamen-
 tum in illis constituo, cuius tanta vis est et soliditas, vt quocunque siue contrariorum longa consuetudine, siue aetatum decursu fiat mutatio, in id tamen ingenitum temperamentum magna semper sit propensio atque procliuitas: cor-
 púsque primam naturam semper redolens, expeditiùs eò se referat vnde decessit. Ex quo fit vt qui à prima origine sit intemperatus, quamuis arte in mediocritatem vindicetur, verè tamen temperatus nusquam sit, neque ei prorsum similis, cui temperies sit ingenita, sed illius duntaxat effigies quaedam et adumbratio, Quinetiam duos si fingamus diuerso natos temperamento, qui fortè quibusuis ex causis in eandem corporis conditionem peruenisse videantur, non tamen iisdem prorsum gaudent et oblectantur: argumentum procul dubio diuersa his superesse naturae primordia, quorum non parua etiam nunc restant vestigia. Quae cùm Hippocrates intima ratione animóque lustraret, vniuersa vno complexus est aphorismo,⁸ quo prodidit per morbos minus periclitari quorum naturae morbus conuenit, aut aetati, aut habitui, aut tempori, quàm quibus non conuenit: eo planè significans nobis aliam ex aetate temperaturam inesse, aliam ingenitam quae ipsa est natura, aliam ex temporis et victus consuetudine: quae diuersae cùm sint et plaerunque [*sic*] pugnantes, in vno corpore consistunt, sed aliis quidem partibus, vt haec carni atque mollioribus, illa fibris duntaxat penitus insideat.

*Quid aetas, quot aetatum differentiae, vtque illarum progressu
 cuiusque temperamentum vertatur. Cap. X.*

[P69] VT multa nos assiduè circumstant incommoda, quorum vi huc illuc traducimur, sic intus nobis ingenerata et ab ortu tradita est causa,

contributed a steady heat to the whole, the proportion of heat will rise with their abundance, and a different temperament will be introduced. The body's temperament will be converted to a hotter one by external causes, but more readily from long indulgence in food and drink, so long as they are of immoderate heat.

Now follows a more exact and ingenious incidental reflection. Since the human body consists of diverse small parts, some softer (like flesh and nerve), others more firm (like membrane, cartilage, bone), all those that yield more readily are first to abandon their share in moderation, but the solids can only be dislodged by a prolonged and severe impact of the causes. In addition, they are interwoven with fibers of much strength, in which a great deal of support resides, so that I reckon no force can ever weaken them, or only feebly and within limits, so that they can hardly yield noticeably in a lifetime. And so I have followed a body of opinion, and assign to them that primary temperament of each body that possesses such power and strength that, whatever direction of change arises from long association with contraries or the passage of time, there is always a powerful tendency towards the inborn temperament. And the body, always retaining the odor of its original nature, returns quite quickly whence it came. Thus it comes about that someone originally intemperate, even if cunningly restored to the midpoint, is still never temperate, nor quite resembles someone born like that, but is just a forgery of him. Again, if we imagine two people born with a different temperament, but happening from whatever causes to have reached the same bodily state, they still do not enjoy quite the same things, which certainly shows that different natural elements live on in them, of which considerable traces remain. When Hippocrates reviewed this with the closest reasoning, he summed it up in a single Aphorism, maintaining that those patients are less at risk whose disease suits their nature or their age or their physique or the season,³ and clearly indicating that in us there is one temperament derived from our age, and another (our nature itself) inborn, and another derived from our seasonal and feeding practices. Though these differ and are largely antagonistic, they coexist in one body, but in different parts: thus one resides in flesh and softer parts, another only deep in the fibers.

Chapter 10. Age, the distinctions between ages, and how with increasing age everyone's temperament changes.

[P69] JUST AS numerous afflictions constantly surround us and force us hither and thither, so there was implanted within us from the start the cause that

cuius necessitate temperamenta decursu vitae commutemus. Haec est illa mortis ac interitus perniciēs, haec intestina calamitas, quam nulla ars, nulla humana industria effugere, sed ne reprimere quidem possit. Etenim sicui ab ortu temperato vel Aesculapius praesit, qui illum ab iis quae foris sunt, aut quae intrò sumuntur causis, saluum et incolumem sic tueatur, vt nullum inde corpus detrimentum capiat: is tamen à semetipso suáque sponte magis magisque conficietur consumetúrque, donec extremum vitae spiritum edet. Illuc dum contendit, plurimas hoc interim spatium mutationes necessariò sustinet. Has qui annorum spatiis et interuallis dimensi primùm discreuerunt, simul aetates appellarunt. Vt sit aetas id vitae curriculum quo luculenter corporis constitutio per se suóque nutu mutatur. Non quaeuis aut proceritati, aut colori, aut erumpentibus pilis, sed quae duntaxat temperamento et primae constitutioni omnium functionum causae incidit conuersio, ea aetatum singularum discrimen facit. Rursum neque ipsius temperamenti ab externis causis, aut aestu immodico, aut caeli ardore, aut intemperatiore viuendi consuetudine mutatio, sed quae ab interiore sit et semper assidente interitus causa, vnica discernit aetates. Quocirca aetatum differentiae plurimùm inter se dissimiles, ex ea ipsa quae incidit varietate statuentur. Vitae ingressu vt omnis animans ex semine et sanguine fluxis humidisque rebus nuper genitus est, ita et humidissimus videri potest: cui caro praehumida et muccosa [*sic*], nerui, vincula, imò et ossa tenera flexibiliáque adeò vt facillè sequantur quocunque ducas. Hinc in dies longiùs procedens plus plúsque siccatur et arescit, vt cùm extremam senectutem attigerit, non modò ossa arida sint et humoris expertia, sed etiam caro neruosa atque dura. Qui ergo sensim aetate progrediens sensim quoque exarescit, quanto ortui erat viciniore, tanto humidior: quantum verò in vitae extremum declinabit, tantum et siccitate contabescet. Vnde intelligitur quod in medio extremorum situm est tempus, id quoque humoris summaeque siccitatis esse particeps atque medium obtinere. Hanc quidem ab humido in siccum animantium progressionem omnium sententiae confirmant. Caeterùm quod alterius est oppositionis, animal statim ut [*sic*] in lucem editum est, ingenti calore affluit, quantum immutabilem persistere ad medium vitae cursum existimant: hinc sensim languescit in extremum, quod omnium est frigidissimum et morti iam simile. Huius oppositionis quod medium est, haudquaquam principio, sed extremo quammaximè aduersatur. Ita enim Galenus singularum aetatum temperamenta tactione explorans, cùm pueros, iuuenes, adolescentes millies considerasset, praeterea eundem infantem puerum adolescentémque factum, hunc nihilo calidiorem deprehensum confirmat, nec puerum quàm aetate florentem, nec aetate florentem quàm puerum. Illius auctoritati vt posterius omnes id concesserunt, sic neque ipsi tot seculis confirmatam opinionem repudiabimus: quanquam fieri posse

compels us to alter our temperaments as life proceeds. It is the deadly destruction, the internal disaster, which no human skill or diligence can escape, or even postpone. For suppose Aesculapius himself takes care of someone temperate from the start, to keep him so protected from external or internal causes that his body comes to no harm from them: he will still get progressively worn out and consumed spontaneously, until he breathes his last. On his way there, he inevitably undergoes very many changes in the meantime. The people who originally marked off these changes by measured intervals of years called them ages at the time. So an age is a stage in life at which the bodily constitution alters of its own accord. It is not an alteration in height or color, or the eruption of hair, but a change that befalls just the temperament and the original constitutional cause of all functions, that creates the difference between individual ages. Again, it is not an alteration of the temperament itself from external causes (excessively warm weather, or atmospheric heat, or a rather intemperate habit of life), but a lethal cause of permanent internal origin, that alone marks off the ages. Therefore the distinctions between the ages, differing greatly one from another, will be established from the actual variety that occurs. At the start of life, every animal can appear very moist, being recently generated from seed and blood, liquid and moist things. Its flesh is very moist and slimy, its nerves and ligaments, even its bones soft and flexible, so that they readily follow your lead. From then on, as it advances day by day it dries up more and more, and so at the end of old age not only are the bones dry and devoid of moisture, but the flesh too is tough and hard. Consequently as one ages little by little, one dries up little by little, being moister the closer one was to one's beginning; the further one descends towards the end of life, the more one will waste away in dryness. This makes it clear that the time at the midpoint of the extremes is the one that shares in moisture and the utmost dryness, and holds the middle place. Everyone's views corroborate this advance of animals from the moist into the dry.

But in relation to the other opposed pair: as soon as an animal emerges into the light it abounds in great heat, to an extent that people think prevails unchanged until midlife. Thereafter it gradually declines to the end, which is the coldest of all and already like death. The midpoint of this pair is opposed most, not to the beginning but to the end. Thus Galen, in exploring by touch the temperaments of the individual ages, examined boys, youths, and adolescents a thousand times, and states besides that the same infant when grown to boyhood and adolescence was not found at all hotter; nor was he hotter as a boy than when in his prime, nor vice versa. Everyone later has followed his lead, and so we too will fall in with the view firmly held by so many ages. I can scarcely

vix intelligo, vt qui infantes, pueros, aetate florentes, tactu expenderit, nihilo sit ipse tot annorum prolapsione vel temperamento, vel tactu immutatus: aut si qua illi mutatio incidit, quomodo tactu tanquam firmo et constanti iudice vti potuit ad aetatum secretionem? Istorum proximus liber pleniorē disputationem conferet. Nunc verò si totius vitae cursum partiemur, iunctisque duarum oppositionum extremis suum aetati cuique temperamentum adferemus, fiet sanè vitae exordium calidum et humidum, extremum frigidum atque siccum: medium sicci et humidi exactam temperiem accipiet, attamen in calido frigidóque nondum id, sed quod illi deinceps est, mediocre apparebit. Si non absolutam illam et indiuiduam temperiem, sed qualem sensus iudicat inuestigamus, temperata aetas censebitur, quae punctum vitae medium modico interuallo antecedit, et ab hoc in aliquantò maius pòst spatium porrigitur. Quicquid mediam hanc aetatem anteit, calido humidóque vincit et excellit, at non peraequè. Initium siquidem calidum est et humidissimum, quod verò sequitur simili calore viget, hu-[P70] more autem longè est inferius: vt quamuis siccum id non fit, sed ne ad mediocritatem quidem depressum, initij tamen collatione siccum plerumque iudicetur. Quod à medio in extremum vitae tempus extenditur, id omne frigido et sicco tenetur, hoc tamen discrimine vt pars vltima tum frigido, tum sicco excellat: nam quae illam praecurrebat, et frigore et siccitate erat temperatior. Vniuersae igitur vitae quinque omnino sunt aetates suis temperamentis insignitae. Omnium prima adolescentia in annum ferè quintum et vicesimum producta, hinc nomen habens, quod tum corpora ob humoris vbertatem plurimùm adolescant. Humoris autem maior minórque copia, complures illius ordines secernit. Infantium aetas, omnium humidissima ad tertium quartúmve annum prouehitur: hinc ad decimum pueritia, inde ad decimumoctauum pubertas, ad vigesimumquintum adolescentia, totius appellationem sortita. Secunda vitae aetas quae florida appellatur, iuuentus est, ad tricesimumquintum aut quadragessimum annum excurrens, cuius propria est venustas, agilitas, et ferocia: calida quidem parcéque humida, quae idcirco praegressae aetatis comparatione solet calida siccáque censerī. Succedit constans et matura sui vbique ferè similis, temperata vix annum attingens quinquagesimum. Illinc ad quintum et sexagesimum ingrauescens est aetas et praecipitata, prima illa senectus, quae siccum frigidúmque corpus efficit, frigidum tamen minus. Omnium postrema vitam claudens aetas est decrepita, frigidissima atque siccissima: quae et vltimum senium dici solet. Hinc eorum manifestè proditur atque detegitur error, qui temperiem ipsam, quatuórque

understand, however, how anyone who has assessed by touch infants, boys, and persons in their prime is not at all changed in temperament or in sense of touch by the passage of so many years. Or if any change has happened to him, how could he use touch as a reliable unchanging arbiter to distinguish the ages?

The next book will provide fuller discussion of these matters. But now, if we divide up the sequence of the whole of life, and combining the extremes of the two opposed pairs assign to each age its temperament, the start of life will certainly turn out hot and wet, and the end cold and dry; the middle will acquire a precise tempering of dry and wet, but in relation to hot and cold not middle age but the age that follows it will appear the midpoint. If we do not inquire into that unqualified individual tempering, but into the one determined by sense, the temperate age will be reckoned the one that starts a short period before the midpoint of life, and extends from there over a somewhat greater period. All that precedes this middle age surpasses in heat and wetness, but not equally [in each]. If the start is hot and extremely wet, what comes next thrives with the same heat, but is much less in [P70] wetness. So it will be judged mostly dry in comparison to the start, although it does not get dry, nor even get lowered to the midpoint.

The time that runs from the middle to the end of life is all possessed by coldness and dryness, but with the reservation that the final part surpasses in both coldness and dryness; what preceded it was more moderate in coldness and dryness. So in the whole of life there are in all five ages marked out by their temperaments. The first of all is adolescence, extending to about the twenty-fifth year, and so named because bodies grow up most then, thanks to the fertility of their moistness. A greater or less supply of moistness marks out several stages in it. Infancy, the most moist of all, extends to the third or fourth year, then childhood to the tenth year, then puberty to the eighteenth, adolescence to the twenty-fifth, picking up the name given to the whole. The second age, the one named blooming, is youth, extending to the thirty-fifth or fortieth year, and possessing its own grace, nimbleness, and fighting spirit; hot and sparingly moist, it is therefore reckoned hot and dry in comparison to the preceding age. The next is steady and mature, changing little anywhere as a rule, moderate and hardly reaching the fiftieth year. From then to the sixty-fifth year comes the growing weight of age hurrying on, the start of old age, which makes the body dry and cold, but less cold [than dry]. Last of all is decrepitude concluding life, very cold and very dry, and usually called the last phase of old age. At this point there comes out into the open the mistake of people who have compared in some numerical fashion the temperament itself and the four

temperamentorum coniugationes vitae aetatibus quadam proportionē con-
tulerunt. Neque enim vlla est aetas calida et sicca absoluto sermone, quòd
vincenti siccitati abundans calor natiuus comes esse non possit: neque vlla ne
senectus quidem frigida et humida est, cùm ex propria partium substantia atque
commoderatione, non ex humorum aut superuacaneorum affluentia tempera-
menti ratio spectetur. Illis quidem annorum numeris vt crebrò eiusmodi tem-
peramentorum mutationem adferentibus aetates circumscripsimus, tametsi aliàs
plerunque ad alios limites excurrunt, cùm vel multò breuior erit vitae cursus, vel
longiùs prorogabitur, ad annum fortassis centesimum. Ab origine autem quod-
cunque quispiam temperamentum acceperit, id necesse est proposita ratione
aetatum decursio commutet. Velut si fortè temperiem is nascens extulerit,
neque vlla deinceps externa causa illam conuertat, procedentibus annis nutu suo
proprioque impetu sic ille ducetur, vt in pueritia atque adolescentia calidus sit et
humidus, florida aetate calidior atque siccior, aetate matura absolutè tem-
peratus, aliis deinceps aetatibus frigidior ac siccior euadat. Quae tametsi ita sunt,
attamen is iudicandus est et puer temperatus, quòd inter pueros mediocritatem
obteneat, et puber quoque et adolescens, itémque iuuenis et constans et senex
temperatus: ita enim comparatè dici videtur. At verò absolutè atque simpliciter
non singulis hic aetatibus, sed ea duntaxat quae matura constansque est, tem-
peratus erit, parem sortitus extremorum portionem. Huius aestimatione tota
pueritia simpliciter calida est, vti et vniuersa senectus frigida atque sicca. Qui
porrò calidus siccusque natus fuerit, inter pueros calidus siccusque viuet, et hanc
innati temperamenti conditionem ac speciem, per omnes aetates quodammodo
retinebit: vt et cùm senium attigerit, calidus atque siccus inter senes persistat.
Quandiu tamen in pueris est, humidus calidusque simpliciter est. Cùm autem
senex euasit, frigidus atque siccus: at aetate media calidus siccusque simpliciter.
Sic enim fit vt cuiusque proprium, et quod à natura ingeneratum vocamus
temperamentum, tale media duntaxat aetate, quae omnium temperatissima est
et cuique familiarissima, purè consistat atque splendescat. Oriuntur itaque et
manant temperamenta tum à primigenia natura, tum ab aetate quae illi comes
est indiuidua: cùmque id quod à natura prodiit, comparatè duntaxat, quod verò
ab aetate, simpliciter dici soleat, consequitur aestimandis temperamentis aetati
quàm naturae vim tribui maiorem, et eam quae ex aetatum decursu fit tempera-
menti speciem, ei tum victoria tum nomine praeferri, quam

combinations of temperaments on the one hand, and the ages of life on the other. For there is no age that is hot and dry in absolute terms, because when dryness is triumphing, abundant innate heat cannot be its natural companion. Nor is there any age that is cold and moist, not even old age, since the basis of the temperament depends on the particular substance and cooperative restraint of the parts, not on abundance of humors or of redundant surpluses.

We have confined the ages to these numbers of years because they are the numbers that often produce a change of temperament of this kind, yet on other occasions they extend considerably to reach other limits, when the span of life either is much shorter, or is prolonged, perhaps to the hundredth year. And whatever temperament anyone acquired at the start, the onslaught of the ages inevitably alters it, for the reason given. For instance, if one happens to have obtained a temperament at birth and no external cause alters it later, with the passage of the years one will be guided of one's own volition and initiative so as to be hot and moist in boyhood and adolescence, hotter and drier in the blooming age, in maturity temperate without qualification, and end up colder and drier in the other subsequent ages. Although this is so, yet one should be considered temperate as a boy, through reaching the midpoint among boys, and in puberty and adolescence, and again as a youth and in maturity and in old age. This seems the right way to put it comparatively. But in fact one will not be temperate, in the pure and unqualified sense of the word, at the individual ages, but just at the age of steady maturity, picking up an equal part of the limits. By this reckoning the whole of childhood is purely hot, just as all of old age is cold and dry. Further, anyone who was born hot and dry will live hot and dry among the boys, and this state and form of the inborn temperament he will somehow keep through every age, so that after reaching old age he stays hot and dry among the elderly. Yet as long as he is among boys, he is moist and hot without qualification. When he has reached old age, he is cold and dry; but in middle age hot and dry without qualification. Thus it comes about that everyone's particular temperament, which we call the temperament created in him by nature, stands out in vivid purity as such only at middle age, of all ages the most temperate and most closely identified with each person. So temperaments spring both from the original nature and from the age that is its inseparable companion. And since the part from nature is usually mentioned only in comparison, but the part from age without qualification, it follows that in assessing temperaments greater weight is given to age than to nature, and the temperament's form that is due to the advance of age gets the better of what

natura ortúsque contulit. De his iam satis multa.

Temperamentum nullum biliosum, sanguineum, pituitosum, aut melancholicum dici oportere. Cap. XI.

[P71] AB ELEMENTORUM viribus primò similium partium, ex his deinde corporis vniuersi compositionem ductam esse rationibus confirmatum est, vt proinde palàm esse debeat omnem temperamenti rationem elementis primùm deberi, his acceptam referri, in iis sitam esse, vt quae totius substantiam compleuerunt. Humores ipsáque superuacanea corporis partes non esse, sed eoduntaxat contineri, idcirco et ab Hippocrate contenta dici, superiore quidem libro dictum à nobis est, et posthac plenius fusiúsque demonstrabitur. Quocirca neque ab humoribus, neque ab illis superuacaneis potest corporis eiúsque partium temperamentum aestimari: neque demum ab illorum dominatu et vbertate fas est temperamento cuiquam nomen imponere. Hinc fit vt ij laqueis inexplicabilibus sese inuoluant, qui nullo nominum rerúmque delectu, hunc (verbi gratia) bilioso temperamento esse pronuntiant, illum sanguineo, pituitoso, aut melancholico alium: cùm haec non temperamentorum, sed dominantium humorum sint nomina. Cui enim sanguinis eiúsque optimi plurimum inest, is iure sanguineus dici debet, vt cui bilis flaua exuperat biliosus, cui atra melancholicus, cui denique pituita pituitosus. Humorum istae redundantiae confinibus sibi temperamentis haud semper respondent: quòd non rarò candidos et molles eósque tactu frigidos obseruare sit, quibus ingens bilis copia quotidie reiicitur: vti et alios hirtos, subnigros atque graciles, qui huius eluuiei minimum con-gesserunt. Videas praeterea non paucos prima origine frigidum siccúmque temperamentum adeptos, quos tamen melancholicos esse minimè iudices, neque atrae bilis proluuie suffusos. Quin et senes extremi quorum aetas frigido siccóque lacessitur, minimum melancholiae coaceruant, sed si quis his superfluit noxius humor, is maximè pituitosus est: vnde et senes à superuacuorum redundantia pituitosos esse omnes confirmant. Hinc multi rerum affinitate capti, eos quoque frigido humidóque temperamento prodiderunt: quos nihilominus superior ea demonstratio arguit et insimulat, qua confectum est, eum temperamenti statum aetate nulla posse recipi, sed continuò vt editum est animal, annorum numero et diuturnitate

nature and origin have contributed, both by conquest and by name. Enough now upon these topics.

Chapter II. No temperament should be called bilious,
sanguineous, phlegmatic, or melancholic.

[P71] SOUND REASONS establish that the composition, first of the similar parts and then of the whole body made from them, is derived from the powers of the elements. Accordingly it should be common knowledge that the whole basis of the temperament is due first of all to the elements, is traceable back to them, depends on them, as they have filled up the substance of the whole. We said in the earlier book, and will later prove more fully and extensively, that the humors and the surpluses themselves are not parts of the body, but are simply contained by it, and on that account were called “contents” by Hippocrates. Consequently the temperament of the body and of its parts cannot be evaluated either from the humors or from these surpluses. Nor can any temperament be rightly named from their predominance and abundance. Thus it comes about that people enmesh themselves inextricably when they adjudge one man (for instance) as of a bilious temperament, another of a sanguine, another of a phlegmatic, another of a melancholic, without discrimination of names or things; for these are not the names of temperaments, but of predominating humors. A man in whom resides plenty of blood, and of the best too, ought rightly to be called sanguine, a man with abundance of yellow bile bilious, a man with abundance of black bile melancholic, a man with abundance of phlegm phlegmatic. These superfluities of humors do not always correspond to the related temperaments; quite often people who are fair-skinned and effeminate and also cold to the touch turn out to eject a large quantity of bile daily, and others who are hairy, swarthy and slender have accumulated very little of this waste. You may see too quite a number who acquired originally a cold dry temperament, yet you would hardly judge them melancholic nor suffused with an outpouring of black bile. Further, very old men, whose age is harassed by cold and dryness, accumulate very little melancholy, and if they have a surplus of any harmful humor, it is particularly phlegmatic; so everyone agrees that the elderly too are phlegmatic through an excess of superfluities. Hence many people, entrapped by the close relationship of things, have maintained that the elderly are also of a cold and wet temperament, although this view is confuted and rebuked by the argument above that established that such a temperament could not be admitted at any age, but the body gets drier with the passage of the

corpus siccus euadere. Huc accedit, externarum causarum vi, multoque magis alimentorum varia substantia et facultate, aliàs bilem, aut flauam, aut atram, aliàs pituitam in nobis congeri ac succrescere, cuius nequit origo corporis constitutioni tanquam efficienti causae tribui. Quis quaeso tam delirus sit, ut in eo humore temperamentum collocet, qui totus interdum praeter naturam est, cui nulla cum corpore communio familiaris intercedit? Ergo quamuis qui prima aetate per vasa sparsus est humor, purioris sanguinis speciem ostendat, proxima dein aetate is corporis ardore siccitatēque ad flauae bilis naturam trahatur, tertia omnium fiat humorum quaedam moderatio, quarta melancholicus humor, postrema pituitosus ab caloris coctionisque infirmitatem redundet: quoniam tamen hunc ordinem externarum causarum plerumque vis inuertit, neque corporis perpetuò una est et eadem atque humorum conditio, sed plerumque diuersa, non utique ex humoribus, sed ex constitutione propria definiendum est corporis temperamentum. Quae humorum sunt nomina periti artificis non est corpori accommodare: quare nullum prorsus temperamentum sanguineum dicere permittimus, ut nullum biliosum, nullum melancholicum vel pituitosum, quamuis aliàs biliosum hominem, aliàs sanguineum, pituitosum aut melancholicum rectē appellemus. Videor equidem iam omnem de temperamentis disputationem compleuisse: cui nihil attinet illorum internoscendorum signa subiungere, in propriam tractationem commodius relata.

LIBER TERTII DE TEMPERAMENTIS FINIS.

years, starting right at birth. In addition, through the power of outside causes, and much more through the varied substance and faculty of foods, there gathers and grows up in us at one time bile (yellow or black), at another phlegm, and its origin cannot be attributed to the bodily constitution as efficient cause. Tell me, who could be so crazy as to locate the temperament in the humor that is for the moment entirely preternatural, and possesses no intimate association with the body? Therefore, the humor that is dispersed through the vessels at the start of life exhibits the form of rather pure blood, in the next age it is attracted by the heat and dryness of the body towards the nature of yellow bile; in the third age there is a kind of restraining of all the humors; in the fourth there is melancholic humor; in the last phlegmatic humor abounds because of the weakness of heat and coction. And nevertheless, since as a rule the power of outside causes reverses this sequence, and there is not one permanent unvarying bodily and humoral state, but usually a changing one, the temperament of the body is not necessarily to be determined from the humors, but from the particular constitution. It is not professional to adapt the names of the humors to the body: so we do not allow any temperament to be called sanguine, bilious, melancholic or phlegmatic, though sometimes we correctly call a man bilious, sometimes sanguine, phlegmatic or melancholic. I think I have now completed the discussion of temperaments. Including the signs for distinguishing them is inappropriate, since they are better transferred to be treated on their own.



DE SPIRITIBUS ET INNATO CALIDO. LIBER IIII.

*Calorem quendam in nobis cunctisque viuentibus inesse,
eúmque diuinum. Cap. I.*

[P72] UNIERSAM HOMINIS naturam cùm altiùs inuestigare et persequi con-
aremur, primùm quidem concretum hoc corpus in minimas quasque similes
particulas anatome dissoluimus. Hinc verò aliam earum compositionem si qua
erat speculantibus, deprehensum est vnamquamque ex primis simplicibúsque
rerum naturis, terra, aqua, aëre et igni constare: ex harum permistione varias
enasci temperamentorum differentias, quorum sua cuique parti proprietas insid-
eret. Nondum autem ab hac contemplatione digressi, rursus scrutemur ecquid
praeterea parti cuique penitùs inhaerescit aut assidet, quod pleniorẽ illius
cognitionem faciat. Quid illa sunt vetustioribus medicis celebrata, innatus calor,
spiritus, humidum primigenium, quid natura atque triplex in similaribus sub-
stantia, vt haec singula consistent, vnde et quibus viribus gubernentur. Quoniam
autem vnus calor prae caeteris sensum manifestè ferit, ab hoc ceu notiore
inducto exordio, reliqua serie quadam quasi conserta ex aliis alia nectemus.
Animantium generi communi lege est à natura tributum, vt insiti vi caloris vitam
agent. Primùm enim illas dum in viuis numerantur, caloris temperatione perfun-
di, morte verò consumptas hoc prorsus extincto refrigerari, vel sensus ipse
declarat, nulláque id alia demonstratione, sed vnus est sensus praestantia confir-
mandum, ceu communi quadam animi notione. Quanquam verò in stirpibus
minùs aperta et euidentis est caloris inspectio, eas tamen non minus quàm
animantes hoc salutari calore conseruari, omnémque omnium salutem hinc
oriri, perspectum ei fiet qui naturae opera effectúsque aestimabit. Constans enim
est et rata sententia, omnia viuentia propter inclusum in se calorem viuere, illius
beneficio alimentum trahere, conficere, eóque nutriri ac sustineri, augescere,
procreare, animantes praeterea sensu affici et moueri: quantóque perfectiora
haec fuerint opera,



BOOK 4

THE SPIRITS AND THE INNATE HEAT

Chapter 1. A heat resides in us and all living things, and is divine.

[P72] WHEN WE were attempting to pursue a more searching inquiry into the whole nature of man, we first broke down this composite body by dissection into the smallest possible similar particles. Next, by searching for a further structure for them (if there was one), it was found that each single one consisted of the original simple natures of things: earth, water, air, and fire. From their mingling various distinctions of temperaments were found to be derived, temperaments of which each part possessed its special character. Without departing yet from considering this point, let us again examine what more there is that becomes deeply inherent in or attached to each part and brings about a fuller knowledge of it. What are those things familiar to the older physicians: the innate heat, spirit, primitive moisture? What is the nature and the triple substance in similar parts? How is each of these made up, and what are the source and powers that control them? As there is one type of heat that more than the others impinges obviously on the senses, let us open with it, since it is better known, and make a string of the rest, one after another. The general kind of animals have it lawfully granted to them by nature to conduct their life by the power of resident heat. First of all, even our ability to sense indicates that while they are among the living, they are pervaded with a temperament of heat, but after death, with the heat quite out, they chill; no confirmation from further proof is needed, only confirmation from the superiority of one sense, as from some general idea of the mind. Although the evidence of heat in plants is less obvious, anyone who takes account of the work and performance of nature will discern that they are maintained by this health-giving heat just as much as animals, and that the whole well-being of all of them stems from this. The view is permanently accepted that all living things live by means of the heat enclosed within them, and thanks to it draw in their nutriment, digest it, get nourished and supported by it, grow, and procreate, and animals in addition are stirred and moved by sensation. And the more complete these achievements, the more

tanto caloris vim atque substantiam vberiore adesse. Quod si vlla id ratione suaderi debet, vnus Solis praestantia spectetur, qui dux et princeps moderatôr-que mundi cuncta viuientia luce sua lustrans, illa pariter caloris sui temperatione fouet, et ad ea quae dixi opera suscitât. Haec si externo calore fota agunt, impediuntur frigore, nónne optima ratio est quempiam in eis calorem inesse operum effectorem, eúmque Solis maximé calori concordem esset et consentaneum? Rectè igitur Aristoteles vitam vno calore contineri, sine calore neque animalia neque stirpes viuere, tanquam protritum et peruulgatum memoriae mandauit, qui et mortem caloris extinctionem esse definiuit. Itaque huius imitatione vna omnium philosophorum consensio vitam calore finit, mortem caloris extinctione. Quantuluscunque inerat calor in corpore, id ipsum vita fruetur, et quas dixi functiones licet obscuras de se promit, neque extremae senectutis frigus quod in temperamento dominatur, huius potest caloris superare vires. Hoc viuunt serpentes, quas tamen temperamento frigiditas esse commemorant. Hoc viuunt papauer, mandragora, et vniuersum frigidarum stirpium genus. Ex quo iam video posse quasi connexum quippiam effici, calorem hunc supra elementorum naturam esse. Ab eo enim contrariorum quod suppar est ac infirmius, alterius excellentis conspectu nihil quicquam agi potest, sed tota misti actio in id quod exuperat tanquam in vincentem causam refertur. Atque in earum stirpium quas connumeravi temperamento, calor depressus est, et [P73] Inferior quàm frigus: non igitur hic vi et operibus potest frigus superare, neque in hunc tanquam in efficientem causam possunt vitae functiones referri. Quocirca si quis calor vitae functionum effector est, vt certè est, nequaquam is esse potest qui in temperamenti mistione diminutus est ac mutilus. Quare necesse est hunc vitae calorem praestantioris cuiusdam esse originis, neque ignei elementi rudioris naturam redolere, quemadmodum alio loco vberius disputatum est à nobis. Hinc praeclara et eximia quadam mentis agitatione videtur Aristoteles mortem definiens, vitali huic calori non frigus tanquam contrarium opposuisse, sed extinctionem quae eius ipsius est priuatio. Vt igitur lumini contrarium nihil est, sed aduersae tenebrae illius sunt priuatio, atque si vel minimum luminis corpus illustret, idipsum illuminatum dicimus: sic et de vitali calore statuo, qui quantuluscunque corpus possideat, idipsum regit atque moderatur, calidúmque denuntiat. Qui volet huius essentiam plenius cognoscere, ob oculos sibi proponat sulphur et arrhenicum, quae calidissima quidem cùm sint, et igneo elemento confertissima, vt plerunque nos vrant, tamen vitali hoc calore destituta iacent, sicuti et vniuersum inanimorum genus: quod argumentum planè conuincit igneum non esse, neque ab elementorum mistione hunc ortum quem proponimus calorem. Quinetiam animantis demortuae cadauer, tametsi partium ac

liberally the power and substance of heat are available. If any basis is needed for advocating this, let it be the excellence of the Sun alone that is scrutinized: it acts as leader and ruler and regulator of the world, sheds its light over all living things, warms them equally by the temperament of its heat, and rouses them to the functions I mentioned. If they perform them when warmed by heat from outside, and are hampered by cold, is not the best reason for this that any heat in them is the originator of functions, and is extremely at one with the Sun's heat? So Aristotle was right to record as a truism that life is associated with heat alone, and that neither animals nor plants survive without heat; and he defined death as the quenching of the heat. Consequently, following him, all philosophers are of one mind in reckoning life by heat and death by the quenching of the heat. However little heat there is in it, the body will still enjoy life, and will produce from itself the functions I mentioned, though they may not be obvious. Not even the cold of extreme old age that predominates in the temperament can get the better of the powers of this heat. Snakes live by it, though reputed to be cold in temperament. Poppy, mandrake, and the whole race of cold plants live by it. From this I now see that a sort of deduction can be made, that this heat is above the nature of elements. For nothing whatever can be achieved by the one of the contraries that is nearly equal and weaker when it is within range of the other's superiority, but the whole activity of the mixture is related to the one that is superior, as the prevailing cause. And in the temperament of the plants that I included, the heat is lowered and is less than the cold. [P73] Thus cold cannot prevail here by its power and effects, and the functions of life cannot be related to it as to an efficient cause. Therefore, if there is a heat that brings about vital functions (and indeed there is), it certainly cannot be the heat that is reduced and impaired in the mingling of the temperament. Hence this vital heat must be of some surpassing origin, and not reek of the coarser nature of elemental fire, as I have argued more fully elsewhere. So it was evidently a notable and distinguished idea of Aristotle's when defining death, that it is not cold that he made the contrary of this heat, but death, the lack of it. Light has no contrary, but darkness ahead is the lack of it, and if even a glimmer reaches a body, we call it lit. In the same way my view of vital heat is that however little resides in a body, it controls it, and declares it hot. Anyone who wants a fuller grasp of its essence should place sulphur and yellow arsenic before his eyes; they are very hot, and very full of the element fire, so as usually to burn us, yet devoid of this vital heat, like the whole kind of inanimate things. This is convincing evidence that the heat we are discussing is not fiery nor derived from a mixture of elements. Further, the corpse of a dead animal, though its parts and its

totius structuram figurámque retinet, caloris tamen huius ne minimum quidem habet: haberet autem si ab elementis nasceretur, cùm in partibus singulis aliqua supersit et resideat quatuor elementorum permistio. Vnde intelligi potest calorem eum per quem vita inerat, non ex prima elementorum mistione, sed aliunde ortu recondito fluxisse.

*Spiritum quendam cunctis datum viuentibus, qui vitae calorem
continet. Cap. II.*

QUONIAM IGITUR calor is indissolubili adhaesione corporis moli consertus non est, sed ab ea separari seiungique potest, necesse est extra molem eam sit, tanquam assumptum quippiam et aduentitium. Atqui cùm nequeat simplex calor in qualitatis genere constitutus, sine sede et vehiculo in omne corpus permeare, huc illúcque momento diffundi, qualiter tamen hunc à corde per omnes arterias partibus singulis impartiri cernimus: fuit opinor necessarium hunc corpore aliquo fluxu et profluente contineri. Caeterùm nullus humor ad hoc aptus erat et habilis, vt tanta celeritate corpus omne traiceret: quocirca necesse fuit calori materiam substerni substantia tenuissimam, pernecitate velocem, quae simul fouendo calori familiaris esset ac amica. Atque cùm eiusmodi sit aërea, aut si rectiùs appellare velis aetherea, optima ratione debuit talis calori subiici, quae semper aetheris modo incensa ardet, cuique perpetuò calor insidet, vt neutrum possit ab altero dirimi. Plato quidem rariùs eam materiam calore perfusam, spiritum appellauit, ignem frequentius, vt interdum calorem. Aristoteli crebrò spiritus est dictus, nonnunquam calidum atque naturalis calor: aliàs quidem à tenuitate et velocitate, aliàs à viribus et effectum ratione nominis desumpta. Planiùs Hippocrates, qui nusquam addubitauit hunc spiritum nuncupare, ex eo quòd eximiis viribus cùm praeditus sit, oculorum tamen effugit obtutum: etenim et aërem, et ventum, et auram, et vnamquamque substantiam quae sub aspectum non cadit, sic dicere consueuerunt. Ad huius profectò imitationem Stoici spiritum ex splendida, perspicua, nec aspectabili substantia constare rectè quidem prodiderunt, eo tamen falsi, quòd hunc tum naturae, tum animae substantiam esse pronuntiant, nihil eo praestantius, nihil diuinius investigantes. Quò autem spiritus necessitas atque substantia pleniùs demonstretur, repetenda sunt et replicanda veterum philosophorum decreta: quorum primi Academici cùm perspicerent fieri non posse vt naturae quammaximè disparet, nullius idonei medij interiectu societatem inirent coiréntque, animum nostrum à summo rerum opifice conditum,

entirety keep their structure and shape, nevertheless has none of this heat at all; it would have if it were derived from elements, since some assortment of the four elements holds out in individual parts. Hence it can be inferred that the heat that enabled life to be present did not emanate from the original mix of elements, but from an obscure source elsewhere.

Chapter 2. A spirit given to all living things is associated with the vital heat.

AS THIS heat is not bound to the body's mass by an unbreakable attachment, but can be separated from it, it must be outside the mass, like an extraneous addition. But heat pure and simple, endowed with the kind of a quality, cannot make its way into the whole of the body without any base or means of transport, and be dispersed here and there in a moment, in the way that we find it shared out by the heart through all the arteries to the individual parts; so it had, I think, to be associated with some fluid body. But there was no humor fit to travel so fast through the whole body. So a material of the most rarefied substance was required as a basis for the heat, fast-moving, to be at the same time an intimate associate for fostering the heat. Since a thing of that kind is airy, or if you prefer a more correct name, ethereal, on the best reasoning it is the sort of thing that should underlie heat, being always on fire like ether, and with heat continuously resident in it, so that neither can be parted from the other. This material, imbued as it is with heat, Plato referred to occasionally as "spirit," but more often as "fire" and sometimes as "heat." Aristotle often called it "spirit," sometimes "hotness" and "natural heat," a name being chosen at times on the basis of its rarefied and fast-traveling nature, and at times because of its powers and effectiveness. Hippocrates was clearer:¹ he never hesitated to call it spirit, because it baffled vision, yet possessed exceptional powers; this was what they usually called air, and wind, and breeze, and any substance that does not show itself to the gaze. The Stoics, presumably following him, held correctly that spirit consisted of bright, transparent, invisible substance, but erred in declaring that it was the substance both of nature and of the soul, and in failing to track down anything more excellent and divine. To prove more adequately the necessity and substance of spirit, the decisions of the ancient philosophers need recapitulation, among whom the Academics were first to realize that it was impossible for utterly different natures to enter a combining association, except by the intervention of some suitable intermediary. They considered that before our soul ["animus"] (the work of the supreme craftsman of things)

priusquam emanaret immigrarétque denso huic et concreto corpori, censuerunt corpore quodam illustri, puro et astro simili tanquam simplici veste indui: quod immortale et sempiternum nunquam ab animo absolui [P74] diuellique posset, et sine quo non fieret huius mundi incola. Ab hoc deinde alterum corpus animo circumiecerunt, tenue illud quidem ac simplex, sed tamen impurius, minùs illustre et splendidum superiore: non ab summo id opifice procreatum, verùm elementorum praesertimque tenuiorum permistione concretum, à quibus nomen inueniens aëreum et aethereum appellatur. Duobus hisce corporibus iam stipatus animus, in tertium hoc mortale caducumque corpus, seu potius in tetrum et tenebricosum carcerem tanquam exul deiectus, terrarum fit hospes, donec effracto carcere alacer et liber in patriam reuersus, municeps fiat et ciuis deorum. Hanc corporis atque animi communionem confirmans Alexander Aphrodiseius, spiritum quem proposuimus ait perquam idoneum vinculum illis interponi, qui aduersas naturas interiectu suo conciliet atque contineat. Is enim extremo vtrique familiaris et accommodatus, cùm non sit prorsus sine corpore, crasso quidem corpori inseri potest: cùm verò tenuior splendidiórque sit, potest cum animo connecti. Sícque vtriusque quodammodo particeps, naturam corporis expertem cum natura corporea copulat, immortalem cum mortali, puram cum impura, diuinam cum terrena. Haec quanquam mentis corporisque communionem non nisi spiritus interiecti nexu fieri demonstrant, eadem nihilóminus et caeteris animae partibus caducis par est accommodare. Etenim animae pars mortali conditione genita, impura licet neque vt mens sincera sit, longo tamen interuallo terreni huius concretique corporis statum antecedit, vt citra vinculum ei nequeat inhaerescere. Quocirca rectè prodidit Aristoteles in semine spumosóque corpore spiritum, in spiritu naturam contineri, quae proportionem respondet elemento stellarum: apertè quidem significans spiritum hunc inter corpus et diuinam illam naturam, tanquam commune quoddam vinculum interponi. Neque verò menti solùm, sed et vniciue animae parti caducae proprium spiritum attribuit, omnémque animae facultatem affirmat corpus aliud participare, ídque magis diuinum quàm quae elementa dicuntur, atque prout nobilitate obscuritatéve animae inter se differunt, ita et huius corporis naturam distare. Quapropter si tum Aristotelis, tum caeterorum rationes iudicio certo ponderemus, palàm fiet vnamquanque animae partem spiritu quodam ceu fundamento niti, per quem tum corpori insidet, tum omne officij munus exequitur. Est igitur spiritus corpus aethereum, caloris facultatúmque sedes et vinculum, primúmque obeundae functionis instrumentum. Quisquis illius substantiam et statum nondum plenè

appeared and entered into this compact solid body, it was clad in some shining body, pure and starlike, as a simple garment, and this, being immortal and eternal, could never be [P74] parted from the mind, which could not become an inhabitant of this world without it.

Then they went on to place another body around the mind, a thin and simple one, but rather impure, less shining and bright than the previous one. This one is not the work of the supreme craftsman, but composed from a mixture of elements, particularly the more rarefied ones, from which it acquires the name airy and ethereal. Pent now in these two bodies, the mind is banished into this third body, a mortal and transient one, or rather it is exiled into a foul gloomy prison, and becomes a visitor to the earth, until it bursts out to return nimbly to the freedom of its fatherland, and becomes a citizen of heaven ["deorum"]. Alexander of Aphrodisias² corroborates this association of body and mind, and says that the spirit we put forward is a very suitable link between them, intervening to reconcile and hold opposed natures together. For it is exceedingly intimate with both, and not being completely devoid of body, can be placed in a coarse body. But being more rarefied and bright, it can be linked to the mind. Sharing thus in both after a fashion, it bonds a nature without body to corporeal nature, the immortal to the mortal, the pure to the impure, the divine to the earthy. Though this [theory] shows that the association of mind and body can only come about through the link and interposition of spirit, it is reasonable to adapt it to the rest of the transient parts of the soul ["anima"]. For the part of the soul that is brought into being in a mortal condition, blemished though it may be and lacking mind's purity, still ranks far ahead of this earthy composite body, so that it cannot attach to it without a link. So Aristotle was right to hold that spirit was enclosed in seed and a foamy body, and that a nature was enclosed in spirit that by analogy corresponds to the element of the stars. He meant explicitly that this spirit is interposed as a sort of shared bond between the body and the celebrated divine nature. He allots its own particular spirit, not to the mind alone, but to every transient part of the soul, and asserts that every faculty of the soul shares another body, one more divine than the so-called elements; and just as souls vary in prominence or obscurity, so the nature of this body differs. Consequently, if we weigh up with steady judgment the reasonings of both Aristotle and the rest, it will become evident that each part of the soul depends upon some spirit as its basis, through which it resides in the body and discharges all its duties. So spirit is an ethereal body, the dwelling and bond of heat and of the faculties, and the key instrument for the performance of function. Anyone who has not yet fully grasped its

sit assequutus, corporis nostri structuram contemplatus, arterias adeat, in cordis sinum et in cerebri ventriculos introspeciat, quos dum inanes ac nullius propè humoris participes videbit, neque tamen frustrà ac temerè tantos à natura conditos, haec quidem mente contrectans, mox opinor cogitatione comprehendet praetenuem auram eos tum impleuisse, dum in viuis fuit animal, quae tamen eo animam agente leuissima cùm esset, sine sensu euanuerit. Huius fouendae gratia inspiratione aërem introducimus, qui non modò corpori refrigerationem (haec enim satis posset aliunde comparari) sed pabulum quoque sumministrat. Corporis autem densa moles, eiusmodi subsidio haudquaquam indiget, vt quae crassiore recreatur alimento ex omnium elementorum permissione concreto: quare necessum est aërem hauriri et attrahi, vt finitimae et cuipiam in nobis sui generis substantiae iungatur, eique velut in pastum cedat. Si nulla in nobis esset tenuis et spirituosa substantia, vix vlla profectò nos ad inspirandum necessitas impelleret.

Corporum quae incenduntur exemplo, materiam tum caloris, tum spiritus in nobis cognosci. Cap. III.

NON ALIENUM institutis meis arbitror susceptam tractationem exemplis illustrare, quae licet de medio sumpta erunt, rei tamen omnis plenissimam fidem facient. Igni summus feruor inest et caloris exuperantia, maximè verò flammae, quae propriè noster ignis est et appellatur. Ea autem fumus est aut aëreum corpus accensum, neutro seorsum, sed iunctis ambobus absoluta: huius enim tanquam materia fumus est, cui flagrans calor accedens flammam efficit. Flammam ambiens aër tuetur idoneus, neque crassus neque humore [P75] multo madens: quem si sepimento quodam circumcludimus, vt tum eò nequeat liber affluere et illabi, mox flammam perangustè coarctatam marcescere restinguique conspicamur. Neque ideo solùm aër desideratur, vt vel refrigerationem flammae praestet, vel fumosam exustamque illius fuliginem excipiat: quia ad vtrumque satis esset accommodatus aër densus et humidus, qui tamen flammam fouere non potest. Restat igitur vt tenuis et syncerus aër idcirco sit necessarius, vt flammae tanquam pabulum accedat, et libero flatu alius aliúsque accedens, quasi pastionem se offerat flammae deuorandam. Velim equidem animum cogitationémque referri ad ignem, qui in medicis cucurbitulis aut in angusto conclaui diligenter obturato concluditur. Hunc enim magnam ambientis aëris partem absorbere, id planè declarat, quòd dum rimae vel tenuissimae patefient atque reserabuntur, confestim ac repente summa vi nouus intrò aër irruet et se ingurgitabit, vt eum nimirum resarciat qui antè fuerat exhaustus. Quibus apertum est flammam vt fumosa substantia, ita et ab ambiente aëre foueri atque sustineri.

substance and standing after considering the structure of our body, should visit the arteries, and gaze into the cardiac cavity and the cerebral ventricles; he will see them empty and virtually devoid of humor, but not created so large by nature without a reason; when he turns his mind to them, I think he will soon grasp mentally that a very rarefied air filled them during the animal's life, but while it breathed its last, was so very light that it escaped unperceived.

It is to foster it that we inhale air, which supplies not just cooling for the body (this could be got some other way) but also nourishment. The compact mass of the body stands in no need of assistance of this kind, being restored by coarser provision formed from a mixture of all the elements. Accordingly, air has to be inhaled and drawn in, to be linked to kindred substance and to any that is of its kind in us, and to turn (as it were) into food for it. If we had no rarefied and spirituous substance in us, there would undoubtedly be hardly any need for us to inhale.

Chapter 3. The material of both heat and spirit is recognized in us on the model of bodies that take fire.

I FEEL it is in line with my plans to illustrate the theme I have taken up with examples; though they will be everyday, they will generate the most complete confidence in the whole matter. The greatest peak of heat occurs in fire, and especially in flame, which is particularly fire to us and is so named. It is smoke, or an aerial body kindled, separate from neither, but released when both are combined. Smoke is (as it were) the material of fire, and burning heat when added to it brings about the flame. The flame is guarded by suitable air round it, not coarse, nor damp with much moisture. [P75] If we enclose it in a barrier that prevents it streaming freely out, we soon see the flame in close confinement wilt and go out. Air is not needed just to provide the flame with cooling or to receive its burnt-out smoky soot; for both these purposes thick moist air would suffice, but cannot support a flame. So the conclusion remaining is that thin pure air is needed in order to contribute a sort of nourishment to the flame, and one puff of air following freely on another presents fodder (as it were) for the flame to consume. Personally, I would compare the mind and thought to fire that is carefully kept shut in medical cupping-glasses or in a confined room. There is clear evidence that it absorbs a substantial part of the surrounding air: so long as the smallest cracks remain and get opened, further air forces its way suddenly and violently in and will be engulfed, presumably so as to restore the air that had previously been used up.

Praeter haec autem tertium illi fomentum et pabulum confertur, ex praepingui quadam materia, cuiusmodi in lucerna est oleum. Hoc quidem corporum omnium celerrimè promptissimèque inflammatur, quod tenui substantia multo aëre spiritúque perfusa continetur: deinde adeps, ab hoc reliqua deinceps corpora quae illius conditionem quodammodo imitantur. Quanto enim vnumquodque ad olei naturam propiùs accedit, tanto deprehenditur magis habile et aptum vt inflammetur, quo autem abest longius, hoc ineptius. Vnde conficitur corpus omne quod inflammari potest, olei cuiusdam esse particeps huiúsque solius gratia conflagrare: quodcunque autem olei est expers, flammam non alere. Videbor hoc loco magnum quippiam et veteribus inauditum offundere, sed quòd longè sit verissimum, et multis huius seculi experientiis confirmatum. Nullum enim corpus est ad inflammationem propensum, ex quo syncerum oleum arte non elici possit. Non adeps, non cera, non pix, non resina, non terebinthina, non vllum denique ligni stirpísve genus: nulla radix, nullus flos, nullus fructus, nullum semen: atque in animalibus nulla pars est, siue os, siue neruus, siue membrana aut caro: nihil denique in stirpium aut animantium genere vitam habuit, quod non possit oleum de se profundere, aliud quidem affluentius solóque pressu, aliud parcius maioréque industria: huius etiam causa quaecunque viuunt inflammari posse compertum habemus. Quinetiam inanimorum genus quae complectitur inflammationi subiecta, eadem quoque oleo sunt finitima. Nam sulphur quicumque metallorum naturas perscrutantur, terrae adipem vel oleum appellant, quod moderato calore coctum cogitur atque concrescit. Ergo quaecunque viuunt aluntúrque corpora, pinguem et olei similem continent humorem. Praeter hunc verò et alio perfunduntur, qui minimè est ad inflammationem idoneus, sed superiore magis tenuis et profluens, ab alimentis ascitus et consertus in caecos arctósque viuientium corporum recessus, qui quidem concoctione mutationem atque vires iam accepit, nondum tamen in illorum substantiam planè conuersus: hunc humorem dicere placet alimentarium. Ab hoc demum diuersus est aqueus humor, quo tanquam visco terrenae corporum partes iunctae cohaerent, quique rerum omnium ex elementorum permistione concretarum est communis. Vniuersum inanimorum siue lapidum, siue metallorum genus, hoc ipso conglutinatum sustinetur: at alimentarium aut olei similem humorem neutiquam nouit, sed hi viuentibus duntaxat propriè tribuuntur, vt intelligere sit eosdem ad vitae calorísque tuitionem partes primas obtinere. Triplex id humorum genus quisquis volet perspectum sibi esse, in materia è syluis caesa cogitationem defigat. Virentes enim stirpium ramos, aut ceram, aut picem, aut resinam, instillans vaporarium qui coniecerit, substrati ignis vi primùm aquam dimanare sentiet, ab hac

Thus it is evident that flame is fostered and supported both by smoky substance and by the ambient air. In addition, a third fuel is contributed by such very fatty material as the oil in a lamp. This is the speediest and readiest of all bodies to take fire, because it depends on rarefied substance imbued with much air and spirit. Next comes fat, and after it the rest of the bodies that in some fashion imitate its character. The nearer any of them comes to oil's nature, the more suited it turns out to be to taking fire, and the further it is, the less suited. Hence every inflammable body is caused to have a share of some oil, and take fire on that account only; anything devoid of oil does not support a flame. Here I will appear to be spouting some great matter unknown even to the ancients, but a thing utterly true, and proven by much experience in the present age too. For there is no body capable of being set alight from which technical skill cannot extract a pure oil. Not fat, not wax, not pitch, not resin, not turpentine wood, no kind of wood or plant; no root, no flower, no fruit, no seed; and there is no part of animals, neither bone, nerve, membrane nor flesh; finally, nothing within the kind of plants or animals possessed life yet cannot pour out oil from itself, some overflowing and just on squeezing, the rest more sparingly and with greater effort. We find it proven too that all living things can take fire by virtue of this oil. In addition, inflammable things within the inanimate kind are associated with oil too; everyone that examines the nature of minerals calls sulphur the fat or the oil of earth, which is solidified on digestion by moderate heat. Therefore all bodies that are alive and are nourished contain a fatty humor like oil. But they are pervaded with another too, one barely capable of taking fire, but more rarefied and free-flowing than the previous one, imported from foods and packed into the dark confined recesses of living bodies; it has acquired alteration by digestion and also powers, but is not yet manifestly converted into their substance. It is popularly called the alimentary humor. Finally, the watery humor differs from this one; it sticks the earthly parts of bodies together like glue, and is common to everything that is assembled from a mix of the elements. The whole kind of inanimate things (stones or minerals) holds together by this glue, but knows nothing of the alimentary or the oil-like humor; these are the special privilege of the living only, which makes it comprehensible that they hold the key place in the maintenance of life and heat.

Whoever wants to get this triple kind of humors clear should focus his attention on timber cut from the woods. Anyone who has used green branches of plants, pouring on wax, or pitch, or resin, [to fuel]³ a steam room, will find that the power of the fire below makes the water evaporate first, and then the

dein oleum: quod non prius elici potest quàm illa plenè exaruerint: sic enim mos est exiccata omnia deligere, è quibus oleum elici debet. Si quis porrò ligneam materiem viridem recénsque caesam igni mandet, principiò videbit aegrè incendi, propterea quòd multo scatet humore, quem è terra pro alimento sibi hauserat. Is enim est, qui ab eius extremis dum incalescit emanare solet. Hoc consumpto reliqua substantia promptè à flamma depascitur, quia purior manet pinguis illa [P76] quae olei speciem gerit, alio liquore nullo madefacta. Hanc cùm omnem ignis depopulatus fuerit, flammae tum nihil prorsus erumpet et euolabit: in subiectis tamen carbonibus sua insuper inerit soliditas, ex relicto aqueo humore tenaci et cohaerente, quem in elementorum concretionem acceperant: quo tandem exeso dissipatòque cinis duntaxat aridissimus reliquus erit. Idem propemodum temporis diuturnitas iis affert arboribus, quae in syluis erectae senio siccescunt. Primùm enim exhaustus alimentarius humor deficit, quo tempore dominatur oleo similis humor, possuntque illae ocysimè succendi. Hic verò annis procedentibus adeò exhaurietur [corrected to “exhauritur” in Errata at end of the volume], vt inflammari prorsum nequeant, cùm putrida ligna vulgus appellat, quae solo constant aqueo humore. Postremò autem et hic atteritur [corrected to “atteritur” in Errata at end of the volume], qui tanquam glutinum erat terrenis partibus connectendis: tum igitur dissoluta soliditate caries inuadet, quae extrema est omnium consumptio. Stirpes reliquae omnes, itémque fructus, semina, animantium particulae, easdem propemodum mutationes diuturnitate subeunt. Ergo si rem vniuersam in caput referemus, in corpore quod accensum conflagrat, siue id lignum est, siue lucerna, siue quiduis aliud, flammae proxima materia est fumosus quidam vapor, halitus modò efflatus: in hoc qui summus inest feruor, species quaedam est et perfectio flammae: haec autem aëris circumfluentis continuo accessu fouetur. Halitus porrò ex illa olei substantia suscitatus emergit: quae flammae pabulum est. Ea autem olei substantia in subiecta densiore, aut ligni, aut elychnij¹ materia consistit, vtranque verò alimentarius humor olim fouit, neque sinens dissipari resarsciuit [corrected to “resarsit” in Errata at end of the volume],² copiosiorémque exaggerans eandem auxit.

*Humidi primigenij quod tum caloris, tum spiritus subiecta est
materia, demonstratio. Cap. IIII.*

AD HAEC autem si quae corporis nostri sunt transferimus, spiritus quem in nobis inesse demonstrauius, quia tenui est et aetherea substantia insito calore perfusa, ei proportionem respondet quae propriè flamma appellatur. Neque enim calor ipse solitarius, neque substantia tenuis quam seorsum cogitatione comprehendimus, sed

oil, which cannot be extracted until the fuel is completely dried out. Thus it is usual to pick out all the dried material from which the extraction of oil is required. Again, if anyone consigns green freshly cut timber to the fire, he will observe first that it ignites with difficulty, because it abounds with moisture, which it had drawn up from the earth as its nutriment. This is what usually emerges from the twigs as the heat grows. When it has been got rid of, the rest is quickly consumed by the flame, because the fatty substance that presents the form of [P76] oil stays purer when it is wetted by no other liquid. When the fire has finished ravaging all of this, none at all of the flame will break out and fly away; its solidity will persist besides, in the underlying ashes, out of the residual adherent watery humor that they had received during the solidification of the elements. When it has been consumed and dispersed, only the driest ash will remain. Longevity produces practically the same effect on the trees that dry out from old age in woods, still upright: first of all the alimentary humor is used up and runs out, and at that time a humor resembling oil prevails, and the trees can catch fire very quickly. But this runs so short as the years go by that they cannot take fire at all, and then ordinary people call the wood rotten; it comprises only watery humor. Ultimately even this will be reduced; it was a sort of glue for sticking earthy parts together. Then, as the solidity has broken down, decay will get in, the final destruction of everything. All the rest of the plants, the fruits, seeds, the parts of animals, undergo virtually the same changes with longevity. So, if we take the whole matter back to the start, in a body that ignites when kindled (wood, or a lamp, or anything else) the material closest to the flame is a kind of smoky vapor puffed out like breath. The peak of its heat is a form ["species"] and perfected state ["perfectio"] of flame; it is supported by the continuous access of the ambient air. Furthermore, a vapor aroused from the substance of the oil comes out; it is fuel for the flame. This oil substance depends on ["consistit"] an underlying more compact material (wood, or lamp wick), and the alimentary humor previously fostered both, prevented dispersal, and caused restoration and increase, accumulating more.

Chapter 4. Proof of the original moisture, which is the material underlying both heat and spirit.

IF WE move on to these, which belong to our body, we have shown that the spirit in us, imbued with a rarefied heat resident in ethereal substance, corresponds by analogy ["proportione"] to what is properly called flame. Neither heat on its own, nor rarefied substance that we grasp separately in thought, but

quod ex amborum societate nexūque conditum est, verè ac propriè spiritus dicitur. Hunc autem alit sustinètque pinguis et oleo perquam similis humor, non is quidem adeps quo partes quam plurimas oblini cernimus, sed alius multò dissimilis et aëreus, qui in partium similarium substantiam consertus omnem effugit oculorum aciem, arte tamen et industria potest vt praemonuimus secer- ni. Is tum spiritus, tum innati caloris fundamentum est atque prima substantia, quem proinde de caetero primigenium placet appellare. Is enim primus est, et communis viuientium omnium in quo spiritus calore perfusus primùm et per se considit, adeò vt neutrum esse possit aut diutius permanere citra illius humoris opem. Inest autem in similaribus quibúsque particulis eius generis humor, quem omni viuientium generi esse datum, suprà ratione confecimus. Hunc planè expressit Aristoteles, dum ait: Calidum autem ipsum in nonnullis pingue habetur, quae res simul efficit vt neque facilè inarescat neque facilè refrigeretur. In nonnullis alio succo praeditum est. Haec ille: reuera enim non solùm hic pinguis, sed etiam triplex commemoratus humor tum nostrum calorem, tum omnem solidae partis substantiam continet atque firmat. Os (hoc vnum in primis ad exemplum adhibere liceat) quandiu in animante constitutum alitur et continet in se vim caloris, alimentario madefit et conspergitur humore angustis spatiis affuso. Ab animante autem desectum id auulsúmque, ignis cedit ardoribus incenditurque celeriter, ob pinguem eum humorem qui ad inflammationem est habilis: cùm verò is iam incendio absorptus fuerit, superstes etiám- tum erit ossis constantia et firmitas, idque communis illius ceu visci vi et beneficio. Eadem ferè et in caeteris similaribus est ratio. Triplex itaque cùm sit omnis earum humor elementaris [*sic*; also in 1542 and 1554; presumably it means the same as “elementarius”], primigenius et alimentarius, duo quidem propriam illarum substantiam complent, tertius illis aduentitius quodammodo et externus. Quocirca vitam etiamnum agente animale, hic quidem absorberi siccarique potest, at reliqui duo nunquam funditus, sed neque maiore ex parte disperdi [P77] possunt: nam priusquam in id discrimen res veniat, propria detracta materie spiritus calórque emarcescet, et animal vitam naturae reddet. Dissipata enim materia quae spiritus et caloris propria est sedes, quae spiritum continet atque seruat, quí fieri potest vt spiritus substantia et calor diutius persistat? At verò qui integra valetudine frigorum vi intolerabili adeò opprimuntur, vt quàm mox è vita excedant, iis calor interclusus extinguitur, superstitute quodammodo spiritus materia. Vehemens insuper animi deliquium si hominem rapit, et caloris et spiritus substantiam vnà in breui dissipat, citra vllam primigenij humoris iacturam.

the product of their linked association will truly and properly be called spirit. It is nourished and supported by a fatty humor very like oil, not the fat with which we see very many parts coated, but another very different one, airy, that when packed into the substance of the similar parts escapes the keenest ["*omnem*"] gaze, but can be detached by diligent technical skill, as we announced before. This is the basis and original substance both of spirit and of the innate heat, and consequently is otherwise popularly called "primitive" ["*primigenium*"]; it comes first and is common to all living things, and in it spirit imbued with heat lodged first and of itself, so much so that neither could exist or continue without the aid of that humor.

There is a humor of this kind in each set of small similar parts, and we established previously that it has been given to every kind of living thing. Aristotle put this clearly by saying: hotness itself is found to be fatty in some cases, and this prevents it both from being easily dried and from being easily chilled. In some cases it is endowed with another juice. In Aristotle's words: in fact this humor is recorded not just as fat but as triple, and provides a strong basis both for our heat and for the whole substance of a solid part. Bone (allow me this single example to start with), over the period that it is established in an animal, is nourished, and accommodates the power of heat, is moistened and sprinkled with alimentary humor that penetrates its narrow recesses. But if it is wrenched out of the animal, it yields to the fierceness of fire and is quickly ignited, because of that fatty humor that is prone to take fire. But when that has been taken up by the blaze, there will still remain the resistant strength of the bone, thanks to the strength of that general (so to speak) glue. The same principle applies as a rule in the rest of the similar parts. So, since every humor of these parts is triple—elemental, primitive, and alimentary—two of these fill up their particular substance, and the third is a sort of extra from the outside. Consequently while the animal survives this [third] can be absorbed and dried out, but the other two can never be completely destroyed, nor even the greater part of them. [P77] For before things come to such a pass, with the loss of their particular material the spirit and heat would wither away, and the animal surrender its life to nature. With the dispersal of the material that is the particular base for spirit and heat, and accommodates and guards spirit, how could the substance of spirit and the heat last any longer? Yet in the case of people in sound health so much overwhelmed by unbearable cold that they very soon die, the heat within them is quenched, the material of spirit somehow surviving. Besides, if intense fainting seizes someone, it disperses the substance of heat and spirit together for a short time, without any loss of original humor.

Econtrario [*sic*] autem huius dissolutionem fieri manente spiritus substantia, aut hanc quidem manente natiuo calore dissipari, naturalis rerum ordo haud patitur. Primigenius is quem proprium dixi viuentium humorem, quatenus substantiae nostrae portio quaedam est, à prima statim origine suscepta, ab alimentario distat atque secernitur. Ab aqueo autem abest, quòd tametsi vterque ingenitus est nobis, hic tamen omnium corporum vel inanimorum communis, nihil societatis, nihil commercij habet cum calore et spiritu: ille verò plurimum, vt qui eorum sedes est et fomentum. Hic idcirco est quem prae caeteris natiuum humorem appellarunt, alij proprio si fortè inepto nomine, humidum radicale: nos id vt primigenium ita dicere possumus vitale et salutare humidum, quod spiritus et caloris totiùsque vitae fundamentum est et pabulum.

De triplici similis partis substantia, et de caeteris humorum differentiis. Cap. V.

SIMILAREM VOCATAM particulam simplicem, compositionis expertem, et sui vndique similem sensus aestimatione iudicamus, primámque illi structuram ex elementorum temperatione nasci. At verò ne sic ad vnguem ea temperatio per omnes eius particulas aequabiliter diffusa est, quin aliae aliorum sint elementorum magis minúsve participes: neque cogitatione modò, sed etiam (si quis studiosè penitúsque introspiciat) sensu varietas quaedam animaduerti potest. Vnde si facilis et accurata quaeritur rerum distinctio, pars quaeque similis ex aliis quibusdam substantiis est condita, hae verò ex primarum simpliciúmque quatuor naturarum concreione. Quoniam verò substantias illas nondum partes corporis appellamus, similem partem compositam dicere vsus non admittit, compositionem duntaxat existimans eam quae ex aliis quibusdam particulis consurgit. Substantiae autem illae tres sunt omnes [*sic*] in parte similari positae, solida, carnosa et spiritiosa, his enim vtar recentiorum verbis. Solida primum est lineamentum et stamen illud stabile atque constans, per quod toti robur inest et firmamentum, et qua tanquam basi reliquae substantiae innituntur. Hanc enim ea quae carnosa appellatur vndique circumfundit et obuallat, infercítque spatia inter fibras vacua, quasi rimas expleat: hinc et partis moles rectè dici consuevit. Commune quidem illi carnis nomen est inditum, sed cuius substantia in magna sit varietate. Quae enim musculorum fibris innascitur, propriè caro appellari solet: quae autem visceribus, vt cordi, vt iocineri,

On the contrary, the natural order of things does not permit its loss while the substance of spirit is still present, or let it be dispersed while the native heat is still present. Original humor, the one I called the particular humor of living things, insofar as it forms a part of our substance acquired right at its first origin, is distinct from alimentary humor. And it is separate from watery humor, because both are inborn in us, but watery humor is common to all bodies, even inanimate ones, and has nothing whatever to do with heat and spirit, though original humor has a great deal to do with them, being their base and fuel. So this is the one they called the native humor in preference to the rest, and others called it the radical moistness, a special but possibly unsuitable name. We can refer to it as original [humor], and also as vital and healthy moistness, because it is the basis and food of spirit and heat and of the whole of life.

Chapter 5. The triple substance of a similar part, and the other distinctions between humors.

BY THE assessment of the senses we consider a small part that is called similar as simple, uncompounded, and the same from every point of view; and that it is originally constructed from a temperament of elements. But this temperament is not so exactly evenly distributed throughout its particles as to prevent some of them possessing a greater or less share of other elements; some diversity can be detected not just by thought, but also by the senses, provided one looks carefully and deeply. Hence, if a ready and precise discrimination is required, each similar part is made up from some other substances, and they from the assembly of the four original simple natures [elements]. But we do not yet refer to these substances as parts of the body, and so it is not customary to call a similar part compound, reckoning as compound simply what comes into existence out of some other particles.

There are the following three substances all present in a similar part: solid, fleshy, and spirituous; I shall use the modern terms. Solid substance is the original enduring feature [“lineamentum”] and framework [“stamen”] that contributes a strong foundation to the whole, on which the remaining substances depend as a basis. The substance called fleshy envelops it and hems it in, filling the empty intervals between fibers, as if caulking cracks; hence this used to be correctly called the bulk of the part. The general name of flesh is given to it, but its substance is very diverse: the kind that arises in the fibers of muscles is usually specifically called flesh; the kind that arises in viscera, as in heart, liver,

renibus, lienì, et pulmòni, eam παρέγχυμα Graeci dixerunt, nos affusionem: intestinis, gulae, ventriculo, vtero, vtrique vesicae, arteriis, venis, neruis, et membranìs quaecunque insidet, commune illa quoque nomen mutuatur, vt vnìcuique parti similari sua sit caro. Spirituosam substantiam suprà satis persequuti sumus, praetenuem nempe et aetheream eam quae partis similari essentiam complet et absoluit: illa quidem in solida substantia primùm et maximè consistit, omniùmque functionum est opifex. Quò autem clariora sint omnia, et haec superioribus quasi annexa consentiant, solidam substantiam ex aliis rursum constare meditemur, nempe ex terreno crassamento (hoc interim verbi à Columella³ mutuabor) cuius constantia atque firmitas aqueo humore continetur: mox ex humido primigenio quod vitale et spiritus fundamentum appellauimus. In hoc igitur naturalis spiritus (qui est aetherea substantia paulò antè commemorata) radices egit ab ortu quibus innititur: inde tanquam è seminario prodiens, in carnosam quoque substantiam propagatur, sicque calorem et naturam secum proferens, his partem similem vniuersam [P78] perfundit. Ergo omnes quae in similari corporis parte sunt substantiae numerantur, carnosae et solidae: in solida crassamentum illud terrenum, humidum primigenium, et insitus spiritus. In crassamento praeter terrenam substantiam, aqueus est et tenax is humor, cuius interuentu partes eius cohaerent, firmàque id soliditate consistit. Ne quid autem hìc intactum et quasi praetermissum desiderari possit, quod partium similarium perfectam cognitionem tradat, in aliam huic proximam contemplationem animum relaturi, quatuor humorum quos secundarios propriè appellant genera, ab optimis quibùsque medicis celebrata, istis comparemus. Quod in solida substantia partis similari primum inest crassamentum, humorem id in se continet aqueum, qui cùm sit omnium corporum communis, ad hunc numerum minimè referri debet. Neque is humor primigenius qui nobis insitus est et viuientium proprius, naturalisque spiritus sedes, in solida substantia positus, quem leuiter et inconsideratè videtur Auicennas cum aqueo eundem fecisse, à quo partium robur et firmitas existit. Sed secundariorum vnus constituendus est is humor, qui carnosae vocatur substantia, et qui ceu concretus liquor solidis fibrìs adhaerescens, moles fit similis⁴ partis: hunc manifestò videre licet in carnibus dum igni immodicè torrentur liquari et plurimùm defluere ferrìque in prunas largiter. Alter est qui ceu proximum partis alimentum illi iam annectitur et agglutinatur. Deinde accedit qui nondum quidem agglutinatur et adhaerescit, sed roris vice in partis substantiam diffusus propiùsque adductus illi apponitur. Postea is humor existit qui in exilibus arteriis venisque

kidneys, spleen, and lung, is called *parenchyma* by the Greeks, and affusion by us; all that is present in the intestines, esophagus, stomach, womb, both bladders [urinary and gall], arteries, veins, nerves, and membranes borrows the general name too, so that each similar part has its own sort of flesh.

We have dealt with spirituous substance sufficiently above, that very rarefied and ethereal substance that completes and perfects the essence of a similar part; it is present primarily and mostly in solid substance, and is the craftsman ["*opifex*"] of all functions. To make it all clearer, and fit this as an addition to what has come before, let us ponder how solid substance consists of yet others, that is, of earthy sediment (a term I shall borrow from *Columella* for the moment) whose permanent strength is held in watery humor, and then of original moistness, which we also call vital and the basis of spirit. So in this the natural spirit (the ethereal substance mentioned just before) puts out roots from the start that support it; sprouting from there as if from a seedbed, it propagates into fleshy substance too, and carrying along heat and nature with it in this way, it pervades the whole of the similar part with them.

[P78] Thus all the substances in a similar part of the body are accounted for, fleshy and solid: the earthy sediment, original moistness, and indwelling spirit are included in the solids. In addition to earthy substance, there is in the sediment the watery clinging humor by whose interposition its parts stick together, and the sediment continues strong and solid. To prevent anything being overlooked here that could convey a perfect understanding of the similar parts, let us turn our attention to another consideration relevant to this, and draw a comparison between them and the four kinds of humors appropriately called secondary, and discussed by all the best physicians. The original sediment present in the solid substance of a similar part contains a watery humor within it that, being common to all bodies, ought barely to be assigned to this category. It is not the primitive humor, which is within us and is peculiar to living things, being the residence of natural spirit, placed in solid substance, the humor that *Avicenna* thoughtlessly identified with the aqueous humor from which the steadfast strength of the parts is derived. But this humor should be reckoned one among the secondary humors, and be named fleshy substance; it becomes the bulk of a similar part, sticking to the solid fibers like congealed liquid. This is what can clearly be seen liquefying in overroasted flesh, running down in quantity and flowing widely onto the burning charcoal. Attached to it there is another, behaving like the next food for the part. Then comes one that is not yet attached, but spreads like dew into the substance of the part, and is brought close and applied to it. Afterwards the humor that the slender arteries and veins

continetur, hinc mox ex earum finibus in vacua partium loca influxurus. Hunc quidem esse constat purioris sanguinis portionem multiplici coctione exquisitè elaboratam, et ex qua pars similis aletur. Quocirca tres hi posteriores nequeunt ad similarium substantiam pertinere: quanquam varia commutatione in corporis naturam tandem commigrabunt. Qui in maioribus venis reconditur sanguis, ad haec secundariorum humorum genera neutiquam pertinet, sed eos quatuor primos ac principes humores ac verè succos recipit, de quibus suo loco futura est commemoratio. Iam verò si praescriptum ordinem inuertemus, ex sanguine qui in venis concluditur maioribus, quatuor humores secundarij, consequutione quadam fient. Cùm enim sanguis iam in extrema et ora exilium venarum arteriarumque perductus est, primus humor tum appellatur, secundus autem cùm iam vice alimenti in partium substantiam influxit iisque apponitur: tertius vbi circum partium villos et stamina concrevens illis annectitur et agglutinatur: quartus quum iam illis assimilatur et in earum propriam carnem conuertitur. Itaque secundariorum humorum solus hic quartus est in essentia partis similis.

Quid innatum calidum, quae eius substantia. Cap. VI.

VT AUTEM hic rerum ordo compositiōque disciplinae sibi constet, in quantum hunc humorem toto animo omnique studio incumbendum, explicandumque plenius quid causae erat cur eum in cunctis viuentibus inesse, tot tantisque rationibus contenderemus, quantumque momenti et ponderis ad rem institutam obtineat. Quicquid vitam agit, salutari calore perfusum continetur et regitur: atque is calor qualitas quum sit, totus tamen diuinus est atque caelestis, et in aethereo spiritu subsistit. Cùm autem huius beneficio et munere corpus alioqui frigidum, vniuersum quantum est concalescat, necesse est ei vim inesse caloris valentissimam, quae si pariter siccitate comitaretur nos impendio adureret: atqui non vrit, eam igitur necesse est humoris temperatione perfundi, viuentiumque calorem ac spiritum idoneo cenuientique [*sic*; read “conuenientique” with 1542] humido contineri, quod illius subiecta est et indissolubilis materia: quemadmodum in his corporibus quae apta sunt vt inflammentur, flammæ sedes et pabulum aëreus quidam est humor. At quoniam complures sunt humorum ordines, compluresque in nobis differentiae, aestimandum nunc est quisnam eorum, [comma present in text, as in 1542] salutaris istius caloris sedes esse possit. Postrema duo humorum genera alimenta duntaxat, nondum autem corporis partes haberi, ex dictis fit manifestum: quare in promptu quoque est horum neutrum

contain emerges, on its way to run presently from their ends into the unfilled places in the parts. It is known that this is a component of purer blood, precisely perfected by complex coction, and the similar part will be nourished from it. Consequently these three last-mentioned humors cannot be included in the substance of the similar parts, though after various changes they will finally make their way into the nature of the body.

Blood in the larger veins is not included either in these kinds of secondary humors, but does contain the four first principal humors and (correctly) juices, which will be discussed in their proper place. Now, if we reverse the previous order, from the blood in the greater veins four secondary humors will come into existence, in a kind of sequence. When blood has been drawn out into the ends and mouths of fine veins and arteries, it is called the first humor; it is called the second humor when it has run out into the substance of the parts to serve as food and become applied to them; it is called the third when it congeals around the filaments ["villi"] and framework and bonds to them; it is called the fourth when it is already becoming like them and being changed into their particular flesh. So, among the secondary humors only this fourth one is in the essence of a similar part.

Chapter 6. What the innate heat is and what its substance is.

TO FOLLOW a consistent order of exposition, we must direct our whole careful attention to this fourth humor, and must explain more fully the reason we maintained with such a weight of arguments that it is present in all living things, and that it is of major significance for our purpose. Everything that lives, being imbued with healthy heat, is maintained and controlled; and since this heat is a quality, all of it is divine and heavenly, and exists in ethereal spirit. Since through its helpful activity a body that would otherwise be cold gets all of it hot, there must be in it a most potent power of heat, which if accompanied by an equal amount of dryness would burn us severely. But as it does not, it must be imbued with a tempering of humor, and the heat and spirit of living creatures must be maintained in appropriate wetness, which is the material inseparably underlying it [presumably the heat], just as in inflammable bodies the basis and fuel of the flame is a sort of airy humor.

But there being several series of humors and several distinctions in us, we must work out which of them can be the basis of this healthy heat. It appears clearly from what has been said that the two last kinds of humors are just foods and not yet parts of the body. So it is also obvious that neither of these is the

eam esse quam inuestigamus innati calidi substantiam. Neque praeterea ea fuerit aqueus [P79] humor ex quo suam consistentiam accepit partium solidarum crassamentum: vt qui omnium sit corporum communis. Restat igitur innati calidi substantiam esse, vel carnosam vocatam substantiam, vel id humidum quod radicitus inhaerens vitale et primigenium appellauimus, quódque olei cuiusdam speciem ostendit. Consentaneum autem magis est et ad veritatem propensius, in hoc quàm in illa potius calorem vitae collocari. Permanens enim est et constans humidum hoc primigenium, in solida substantia firmatum, neque nisi annorum aetatisque decursione imminui potest: carnosae substantia frequenter omni aetate vt augeri ita detrahi et extenuari videtur. Illud siquando iacturam accepit, non resarcitur: haec marcore exhausta, rursus in amplam molem assurgit: nam carnosae substantiae magnitudo variatur, etiamsi praeterea non augetur animans. Itaque si innatus calor vitae opifex, tutò nos debet in extremum regere atque moderari, par est vtique hunc in stabili humido permanere. Quin et nostrae originis contemplatio, vitalem calorem vnà cum humido primigenio à semine, carnosam autem substantiam à materno sanguine deriuari commonstrat. Etenim prima foetus conformatione dum similarium partium procreatio institueretur, corpus ipsum seminis, primùm in quaedam rudimenta sese extendit, deinde verò in exactam speciem. Dum enim ea rudimenta ponerentur, videri poterat corpus seminis adumbrationem quandam partium similarium lineamentis suis exhibere, quae quasi fibrae erant et stamina filis quibusdam tenuissimis araneorum similibus contexta. Haec est igitur constans et verè solida partium similarium substantia ex puro semine concreta: ad quam deinde sensim influens et illabens sanguis maternus, villos et stamina vndique circumsedens illic concresebat, fiebátque substantia carnosae ex sanguine: quae affusa inspersáque locis inanibus, moles est partium similarium. Quancunque autem solidior illa substantia ab ortu conditionem acceperit, eandem totius vitae cursu retinet. Nam stamina ex humido liquidóque semine creata, quanquam diurnitate magis magisque siccescunt, dum ad extremum senium quod aridissimum est veniant, semper tamen eius humidi quod à semine contraxerunt, aliquid sibi in omnem vitam recondunt: quod vt recèns [*sic*] natis et infantibus plurimum est, senibus exiguum, ita interiectis aetatibus mediocre. Quantulumcunque idipsum est quod in vitae extremum reconditur, secum id spiritum et calorem ex semine aduexit, hósque retinet tum sibi tum solidae substantiae perennes et indissolubiles. Ex quo intelligi potest carnosam similarium partium substantiam à sanguine, solidam verò et quicquid in eius compositione inest, siue crassamentum, siue humidum primigenium, siue spiritus, siue insitus calor, id omne olim à semine natum processisse, et tanquam illius quaedam portio sit incorrupta, seminis naturam plurimum redolere. Hinc rursus perspicuum euadit innati calidi quam exquirimus substantiam,

substance of innate heat, the substance of our inquiry. Nor again will it have been the watery [P79] humor that gives the sediment of solid parts their consistency; it is common to all bodies. So the remaining possibility is that the substance of innate heat is either the so-called fleshy substance, or the moistness that, being utterly inherent, we called vital and original, and that presents the form of some oil. It is more consistent and closer to the truth for the heat of life to reside in the latter than in the former. For this original moistness is lasting, supported in solid substance, and cannot be reduced except by the advance of years and of age: fleshy substance is often seen to grow or to be reduced at any age. If the moistness has been lost, it is not made good: if fleshy substance has wasted, it rises again to substantial bulk, because its size alters even if the animal does not grow besides. And so, if innate heat, the craftsman of life, has to control us safely to the end, it is absolutely right for it to continue in steady moistness. Again, consideration of our origin demonstrates that the vital heat was derived along with the original moistness from the seed, but the fleshy substance from the maternal blood; at the first shaping of the fetus, while the generation of the similar parts was being organized, the body of the seed thrust itself out first into some initial stages, then into the completed form. While these initial stages were being laid down, the body of the seed could be seen from its outlines to display a kind of sketch of the similar parts, like fibers and warps ["stamina"] woven from some very fine threads like those spiders make. This is, therefore, the permanent and truly solid substance of similar parts, congealed from pure seed. Then the maternal blood oozed over it, wrapped the filaments and warps all around, and kept congealing; and fleshy substance was made out of the blood. Poured into the gaps, it is the bulk of the similar parts. But the more solid substance keeps throughout life whatever state it took on at its beginning. For warps made from moist and liquid seed do dry out more and more with the passage of time until they reach the driest extremity of old age, yet always keep for themselves throughout life something of the moistness they acquired from the seed; being plentiful in the newborn and infants, and scanty in the elderly, it is middling in the intervening ages. However little survives at the end of life, it has brought spirit and heat with it from the seed, and holds onto them as inseparable associates of each other and of solid substance. It can thus be realized that the fleshy substance of similar parts emanates from the blood, but the solid substance and everything that enters into its composition (sediment, or original moistness, or spirit, or resident heat) took its birth long ago from the seed, and as though a part of it were ["sit"] intact, it savors strongly of the nature of seed. Hence again it becomes clear that our topic, the substance

praestantem illam quidem et vitae conseruatricem, non ad carnosam quae ex sanguine prodiit, sed ad primigenium humidum, quod suam semini originem refert acceptam, pertinere. Ergo siqua illius promenda est definitio, calidum innatum est humidum primigenium insito spiritu et calore vndique perfusum. Id nempe humidum cui spiritus et calor ab ortu est inditus, in quo saluus viget et conseruatur. Tribus ergo illis coniunctim innatum calidum continetur, quamquam hoc ipso nomine quidam spiritum ingenitum appellant, at rariùs nec satis propriè. De his hactenus, nunc de natura.

Quid natura medicis, et quae eius substantia. Cap. VII.

QUOD GENERATIM atque vniuersè physici proponunt hoc loco contrahentes, naturam esse definimus vim primam et causam per se nostri opificem et conseruatricem. Hominis enim natura est quae non aliud quicquam procurat, et quae soli addicta homini, quem conformauit gubernat quantum potest longissimè. Etenim ne frustrà condidisse videatur, edito illa operi in omni vita insidet, id nunquam deserit, sed eius gubernacula tractans partes omnes in suum quamque opus ducit et concitat, vt illa ipsa simul omnium functionum causa censi debeat. At illius substantiam quaenam sit peruestiganti, vis [P80] et potestas caloris prima in mentem venit, cui solet omnis effectus causa palàm attribui. At verò qualitas syncera caloris, etiam si diuinus hic sit ac planè coelestis, tamen functionum opifex non erit, neque dum intensione creuit, continuò integriores firmioresque functiones expromit, nisi pariter incrementum accipiat substantia caloris: quocirca necessarium est naturae nomen atque finitionem, non vni calori, sed illius quoque substantiae accommodari: quod et omnes philosophi nunquam accidenti attulerunt, sed alteri compositae rei principio. Moderato autem cuique calori qui aut in sanguine, aut in quouis humorum genere, aut in spiritu, aut in corporis substantia situs est, naturae nomen non nisi promiscuè et fusa nimis appellatione aptari potest. Aptiùs quidem spiritum ingenitum quicumque is fuerit, naturam dixeris. Veruntamen si propriè agendum est, naturae substantia est calidum innatum quale suprà circumscripsimus. Id enim animal ab initio conformauit, auxit, et tanquam omnium operum naturalium causa nutriuit. Natura igitur perinde atque innatus calor tria comprehendit, humidum primigenium, spiritum et calorem, omnia quidem vno eodémque ortu ex semine prognata. Quum veteres naturam et

of the innate heat, important and a guardian of life, is associated, not with fleshy substance that was a product of the blood, but with the original moistness, which derives its origin from the seed. So if a definition of it is to be offered, the innate heat is original moistness imbued throughout with the spirit and heat resident in it. This is of course the moistness into which the spirit and heat were introduced at the start, and in which they thrive unchanged.⁴ Therefore the innate heat resides in these three associated together, although some use this name for inborn spirit, but not often and not really appropriately. Enough on these subjects; now to deal with nature.

*Chapter 7. What nature is to physicians,
and what its substance is.*

As a general overall summary put by students of nature at this point, we define nature as the original power, and in itself our creative cause and preserver. For a man's nature is what has nothing else to attend to, and being assigned only to the man it has fashioned, it controls him as far as possible, for a very long time. To avoid seeming to have created him needlessly, it dwells in its product for the whole of life, never leaving it, and steers him so that all the parts are stimulated and guided to their individual task; thus it ought itself to be regarded as the cause of all functions. But when anyone inquires into its substance, the power and original [P80] strength of heat are first to come to mind, to which the cause of every effect is commonly explicitly attributed. But even if heat is divine and clearly of heavenly origin, its pure quality will not be a craftsman of functions, and during the time it has intensified it does not continuously bring more complete and powerful functions into action, unless the substance of heat acquires a parallel increase; whence the name and description of nature has to be applied not just to heat, but to its substance as well: a name that all philosophers have never applied to the accident, but to the other basis of a compound thing. The name of nature can only be applied in an overly loose and indiscriminate way to each intermediate heat that resides in blood, or in any kind of humors, or in spirit, or in the substance of a body. The inborn spirit (whatever it turns out to be) will better deserve the name of nature. However, if we must be specific, the substance of nature is the innate heat as we have described it above; it shaped the animal from the start, made it grow, and nourished it for (as it were) all natural activities. So, like innate heat, nature includes three components: original moistness, spirit, and heat, all produced from the seed at a single birth. When the ancients announce that nature and the

virium substantiam tum ex spiritu, tum ex carnosa specie, tum ex solidis ipsis simul iunctis constare et compleri pronunciant, potiùs ea quibus sustentur vires enumerant, quàm proprie naturae nomen vsurpent, cùm carnosa illa species nequaquam sit à semine contractae: quae autem verè natura est tota ex semine nascens, animal effinxit, huicque totius vitae cursu moderatur. Quae purè natura dicitur carni non est ingenita, sed in hanc ex solida substantia cui peculiaris est, confertur. Corporis natura, quae et innatum calidum, in solidae partis crassamento tanquam in materia consistit: vt haec solida seminalisque substantia aliorum omnium more, ex materia et natura constitui intelligatur. Caeterùm haec ipsa principia, non vt quae solent accuratè à physicis tractari, simplicia sunt et omnis compositionis expertia: sed etsi fortè sensu simplicia iudicantur, cogitatione tamen ex primis constant elementis se prioribus. Crassamentum enim quod substratum atque subiectum est, ex densis terrenisque elementis plurimum quidem conditum est, non tamen tenuiorum prorsus expers. Natura quae in illo viget, humido primigenio et spiritu calido perficitur, quae aëris atque ignis plurimum in compositione acceperunt, sed tamen terrae et aquae nonnihil, licet id omnino minimum: vt medicis nulla prorsus substantia sit, quae non ex quatuor naturarum temperatione sit concreta. Hinc fit vt rursum naturam quodammodo liceat appellare primum id corporis temperamentum, quod à prima statim origine ex elementorum et caloris diuini perfusione contractum est. Illic tanquam in prima functionum omnium causa consistunt, quicunque caducae naturae limitibus coërciti, nihil supra hanc diuinius quicquam neque ipsam animae substantiam inuestigant. His igitur natura est temperamentum in spiritu et humido primigenio situm: quod quoniam caloris dominio vinciti, calorem quoque natium appellant. Tot modis natura dici solet: nam quod Hippocrates aliquando quatuor humorum congestionem, aliquando corporis formam et figuram hoc nomine signarit, praeter vsum est et consuetudinem loquendi. His iam decursis, pleniùs adeunda nobis est innati calidi et spirituum tractatio, quorum gratia hic à nobis liber fuerat institutus.

*Vt innatum calidum aetatum inclinatione, status mutationem
subeat. Cap. VIII.*

ABUNDANTER CALIDA humidâque est innati calidi substantia, eò cumulator et plenior, quò magis sit caloris humorisque particeps. Talis est omnino in semine mistisque ortus nostri primordiis, quae

substance of powers are made up from both spirit and fleshy substance and the solids linked to them at the same time, they are listing the powers that support them, rather than making proper use of the name of nature, since that fleshy form is not acquired from seed at all; this nature really stems all from the seed, and it formed the animal and controls it [reading “hocque”] over its whole life. What is genuinely called nature is not created in flesh, but is conveyed into it out of the solid substance for which it is specific. The bodily nature, which is also the innate heat, resides in the sediment of the solid part just as in a material; so that this solid substance originating in the seed may be taken as composed of material and nature, like everything else. But unlike the principles that are handled precisely by students of nature, these ones are simple and not combinations. Yet, even if they are perhaps considered simple by the senses, for the mind they are composed from the original elements that precede them. The underlying sediment is mostly formed from solid earthy elements, yet is not totally devoid of more rarefied ones. The nature that thrives in it is the product of original moistness and hot spirit, which have acquired a great deal of air and fire in their makeup, yet some earth and water, though that part is altogether very small. Hence for physicians there is no substance whatever that is not assembled from a tempering of the four natures. Thus it comes about that we can again in a way give the name of nature to that temperament of body that was assembled right from its start through pervasion by the elements and the divine heat. Everyone who is restricted to the bounds of transitory nature does not inquire into anything more divine than this, nor into the substance of the soul, and comes to a halt there, being at the original cause of all functions. For him the temperament is located by nature in spirit and the original moistness. Since it overcomes through the predominance of heat, it is also called the native heat. Nature is usually described in so many ways: Hippocrates did refer sometimes by this name to a heap of the four humors, and sometimes to the form and shape of the body, but this is unorthodox language. Having covered this, a fuller treatment of the innate heat and spirits is needed, which were the motive for this book.

*Chapter 8. Innate heat undergoes a change of state as age
[literally, “ages”] wears on.*

THE SUBSTANCE of innate heat is copiously hot and moist, and the more completely so, the greater the share it has in heat and moisture. It is entirely like this in the seed and the mixed elementary stages of our origin, which have the

caloris atque humoris natiui summum habent complementum, vt aliàs numquam plenius affluere possint. Quae ortui proxima est aetas, tanta istorum abundantia circumfluit, quantam nulla aetas consequuta aut arte aut industria potest excedere, sed ne parem quidem atque primo ortu acceperat, vel exquisitissima viuendi lege conseruare, alioqui perpetuari et sempiternis seculorum aetatibus sustineri posset animans. Illa porrò summa cùm sint infantium aetate, moderata tamen esse dicimus, ipsamque innati calidi substantiam benè temperatam. Qui enim in hac calor [P81] inest, licet sit summus, quia tamen humido perfunditur, mitis est omnino et blandus, nulla feriens acrimonia. Sic et humor licet vberior, haud tamen diffluit, sed calore coërcetur: sic summa quae sunt, ad moderationem quandam exquisitè sunt temperata, vt infantibus et puerulis redundans humor, pari quodammodo spiritu et calore sit aspersus. Hinc aetate progrediente sensim vi caloris membra siccescunt, simul quoque et robur et incrementum consequuntur, non modica quidem humoris portione in accretionem profusa. Id itidem sentiens Hippocrates, ait corpus quodcunque augescit et robur accipit, necessariò calidum esse, illàque ob innati calidi vim conferri. At verò cùm iam ossa, nerui atque membranae non vltrà sequi ducìve possunt, incrementum omne sistitur: tum verò membris summum robur inest, summaeque vires insunt ad animalium operum functionem. Quae profectò argumento sunt, aetatem floridam humidum primigenium iam siccior obtinere. Caeterùm haec aetas inter extrema medium occupauit, neque vt senium ingenti siccitate inarescit, neque vt infantium aetas humore multo affluit: atque in ea mediocritate tametsi humor non satis ad incrementum suppetit, satis tamen est qui possit ingenitum calorem et spiritum, quantum à primordiis acceperat quodammodo asseruare. Ita enim existimant parem adolescenti atque infanti insidere calorem, quia quantum substantiae caloris perpetuus ille fluor ab ineunte aetate dissipauit, tantundem qualitatis et acrimoniae genuit attulitque adolescentia: quandoquidem sicciore facta materia solet calor omnis vires suas vehementiùs proferre. Hac igitur vicissitudine quia disperdita substantia qualitas increuit, parem calorem sensus aestimatio illis fortasse decernit. At verò infantis plurimus est naturalis calor, isque blandus et halitus similis, vt substantiae aestimatione Hippocrates hominem prima die calidissimum statuatur. Iuueni autem caloris substantia, non potest non esse ad quandam paucitatem atque exilitatem redacta, quam ob causam is reuera minùs est calidus: at si qualitas spectatur, calore est acri et intenso. Qui calidissimus est infans, is pariter bene temperatus est, ad cunctas naturae perfunctiones accommodatus. Huius verò comparatione iuuenis intemperatus

highest content of heat and native humor, so that they cannot abound more liberally at any other time. The age that is next to our origin overflows with such a copious supply of them as no later age can exceed by skill or diligence, yet an animal could not keep as much as it had at its origin, even by a very refined mode of life, or become permanent in other respects, or persist over endless periods of time. Further, though heat and moistness are at their peak in infancy, we call them moderate, and call the substance itself of innate heat well-tempered; the heat in this [P81] may be at its peak, but because it is imbued with moistness, it is entirely mild and gentle, with no fierce impact. In this way, the humor may be more copious, but does not melt away, being confined by heat; in this way too, things at their peak are tempered precisely to a moderate level, so that the abounding humor in infants and small children is sprinkled with some equal measure of spirit and heat. Thereafter, as age advances, limbs dry up gradually from the force of heat, and as they do so, gain strength and growth, a substantial part of the humor being expended in growth. Hippocrates is of just the same view, saying that any body that increases and gains strength must be hot, and the power of innate heat is responsible.

But when bones, nerves, and membranes can be led along no further, all growth stops. This is the time when the limbs possess their utmost strength, and the utmost powers are present for the performance of animal tasks. This is certainly evidence that the bloom of youth possesses original moistness that is now drier. But this age took the middle ground, and does not get dry with the gross dryness of old age, nor abound with profuse humor like infancy; and though the humor in this middle stage is not enough for growth, it is capable enough of preserving in a way the amount of inborn heat and spirit it had received from the elementary stages. Thus people suppose that an equal heat resides in the adolescent and in the infant, because the amount of the substance of heat that was dissipated by that endless outflow from the start of adolescence is the same as the amount of the quality and vigor that adolescence generated, since the drier the material gets, the more vigorously heat usually brings all its forces into action. Because in this reciprocal action the quality has increased with the loss of substance, the sensory assessment perhaps finds them equally hot. But the infant has very much natural heat, gentle and like a vapor, so that Hippocrates finds that a person is hottest on the first day of life, by reckoning from the substance. In a youth the substance of heat is inevitably reduced to some scantiness, and hence he is really less hot; but if the quality is considered, it is of a fierce heat. The hottest infant is at the same time well-tempered, adapted to every natural function. In comparison the youth is judged intemper-

censetur, qui acrem igneumque calorem est consequutus, quem etiam aduentitium externumque appellant: non quòd extrinsecus assumptus sit aut accesserit (illuc enim suoapte impetu inuectus est et sublatus) sed quòd bene temperati limites egressus et extra eos positus, non similiter atque ille ad naturae munera vires habeat. Itaque infantes natio calido excellunt, iuuenes aduentitio: multoque magis qui febre iactantur: at natiuus in istis non inest pristino aequalis, nedum maior. Sed ad nos iam redeamus. Ab summo aetatis vigore sensim qualitas et acrimonia caloris marcescit et paulatim collabitur, vsque eo dum is extremo senio languidus contabescat. Quicquid enim subest tanquam calori pabulum, id vniuersum incendio deflagrat aetatis vigore, vt tum accerrimus [*sic*; “acerrimus” in 1542] calor omnia vorans sese nequeat amplius effundere. Hinc verò quoniam nimium exesa dissipataque insiti illius et primigenij humidi substantia, non est satis apta pari calori fouendo, necessum est vt dum sensim humidum absumetur, calor quoque pariter obsolescat: et (vt ait Hippocrates) dum corpus arescere incipiet, defluens ad ruinam frigidius efficiatur: diebusque postremis quanto plus homo extabescit, tanto frigidior necessariò reddatur, vt sui ipsius ratione sit postrema vitae die frigidissimus. Hac igitur ratione innati caloris aliàs substantia, aliàs qualitas aetatum progressu ad ruinam defluens, in perniciem agitur. Caeterum quoniam exhausto pabulo calor vnà restinguitur, si hic causa est quae pabulum absumit, vt certè est, fiet protinus idem calor interitus sui causa. Gaudet quidem et iucundè fruitur humidi commercio, cuius etiam si interitum non expetit, ipsum tamen necessario affert: sublato autem humido consequens est et calorem tolli. Vnde hic calor dum conseruari et perfici naturaliter desiderat, semetipsum is conficit et interimit: et quem sui occasum et obitum non intendit, eum tamen conficit. Sed quoniam nihil quod genitum est et natura constat, primum et per se sui exitium molitur, sed quàm longissimè prorogari et in rerum natura consistere peroptat, ne ipse quidem calor per se et ex instituto, sui interitus causa fuerit, verum vt dicere solent ex accidenti et alterius interiectu. Nam aliud quippiam agens, ipse quippe hu-[P82] midum conficiens, se ipsum pariter diripit atque vastat. Quocirca non alia est ortus nostri, alia interitus causa, sed quaecunque nos genuit et moderatur, ea tandem extremum vitae diem morte conficit. Dixerit hic aliquis. Si summus aetatis vigor calorem profert tactu acerrimum, senectus autem ignauum et inertem, necessitas est medio transitu moderationem quandam percipi caloris, qualem et superior de temperamentis tractatio confirmauit? Quid est igitur quam ob rem non hanc similiter vt infantium aetatem, aut fortasse conuenientiùs

ate; he has acquired fierce and fiery heat, which also goes by the name of extraneous: not because it has been picked up from outside (its own effort brought it in), but because it got beyond the bounds of the well-tempered, and so differs in the powers it has for natural tasks. Thus infants are outstanding in native heat, youths in extraneous heat, and much more those who are racked by fever; but the native heat in them is not at its original level, let alone greater.

But to return to our task. From the stage of life of greatest vigor⁵ on, the quality and fierce impact of heat gradually wilts, and gives way little by little, until its feeble decay in extreme old age. All the underlying fuel for the heat burns out in the blaze of the vigorous stage of life, so that thereafter the violent all-devouring heat can spread itself no further. But then, since the substance of the well-known resident original moistness is too much consumed and dispersed, it is insufficiently capable of supporting an equal heat; and inevitably with the gradual removal of moistness the heat too fades with it. And, as Hippocrates puts it, as the body starts to dry up, it gets colder on its decline towards destruction. In the final days, the more a person wastes, the colder he must become, so that on his own scale he is coldest on the last day of his life. On this basis, at one time it is the innate heat's substance and at another its quality, that with advancing age declines toward destruction and comes to its end.

However, since as the fuel is consumed the heat is destroyed with it, if the heat is the reason the fuel is expended, as indeed it is, it will become the direct cause of its own extinction. It is happy in its association with the moistness, and if it does not aim at its extinction, it inevitably produces it; with the moistness gone, the result is the heat's removal. Hence this heat naturally needs to be preserved and perfected, yet makes an end of itself, and brings about its own decease without meaning to. But as nothing produced and established by nature contrives its own destruction primarily and of itself, but is eager to survive as long as possible and remain in the nature of things, not even heat itself will be the cause of its own destruction of itself and by established practice, but (as is usually said) by accident and the intervention of something else. For any other agent, in virtue of [P82] being a destroyer of moistness, shreds and ravages itself as much. Therefore the causes of our coming into being and of our death are not different; whatever brought us forth and controls us is what ends our last day by death. Someone might have said at this point: "If the age of greatest vigor presents the fiercest heat to touch, but old age presents a torpid heat, must there not be at the halfway point a sort of intermediate value of heat to be perceived, as the earlier discussion of temperaments established? Is there any reason not to reckon this as we do the age of infancy, or perhaps more suitably

liceat in temperatis numerare? Nunc sanè diuersa nobis atque tum est temperati ratio, illic enim temperamenta tactu et qualitatis ordine, hîc substantiae copia et vbertate dimetitur. Quae enim floridae succedit aetas, tactus iudicio temperatum praebet calorem, at verò paucum id est, nec ei simile quod summè expetitur laudatúrque omni vita, et quale infantium aetati inest plurimum, naturae muniis congruentissimum. Pollet enim haec aetas eius humidi facultate, quod tum naturae iucundissimum, tum calori affine temperiem accersit, subsidiúmque confert ad actiones. Altera verò quia siccior aduentitio calore continetur, qui tamen tactione mediocris deprehenditur. Etsi igitur quicumque natiuus calor integer est et valens, is continuò est temperatus: non id tamen retrò commeat, vt qui temperatus sensus iudicio confirmatur, is natiuus sit et nostrae naturae familiaris. Hic animo tractare et contemplari liceat rem cognitione dignissimam, humidi quippe primigenij, atque caloris societatem. Tanta enim est horum consentiens, conspirans et continuata cognatio, vt semper mutuas operas conferant, nihílque vnum efficere possit alterius ope destitutum. Iuueni siquidem etsi par quodammodo atque puero calor insidet, naturae tamen operibus ille obscurior et infirmior est quàm puer, quòd quadam ex parte exhausto humore factus sit aridior. Quod planè argumentum est humorem insitum non minùs atque calorem ad naturae opera conferre. At certè illa esse diuersa declarat quae per aetates incidit mutatio: dum altero constante alterum sensim dissipatur. Huc pertinet quòd humidum tanquam fomentum et pabulum est caloris, calor autem illius beneficio sustinetur: hic vt efficiens est praecipuum, humidum vice materiae substernitur calori, magisque patitur. Quibus magna vi frigoris insitus calor repentè extinguitur (quod hyeme per Alpes iter facientibus tempestas Aquilonia inferre solet) humidum ferè superest: quid enim potuit insperata et repentina morte id tam subitò disperdere? At verò contrà humidum euanescere dissoluíve non potest superstite calore. Qui extrema senectute confracti, naturae necessitate mortem oppetunt, iis vnà cum calore innatum humidum disperditur, vt illius nihil restet aut certè perexiguum, quod non sit satis asseruando calori. Itidem ferè sustinent qui tabifica febre arescentes immatura morte decedunt.

among the temperate stages of life? Certainly we have a different basis now from the one then, for reckoning the temperate: there we measured temperaments by touch and by rank of quality, but here by abundance of substance. The stage of life that follows the blooming stage presents a tempered heat to tactile judgment, but a scanty heat, unlike the one that is greatly sought after and commended throughout life, the sort that is present to the greatest extent in infancy, and is most closely matched to the natural functions. This stage of life predominates in the faculty of the moistness that, being both most delightful to nature and akin to heat, introduces a due proportion, and provides help for action. The other stage [presumably the one after the blooming stage], being drier, is sustained by extraneous heat, which is however found intermediate by touch. So any native heat that is in sound health is necessarily tempered. It does not retrace its progress, so that the heat that is native and closely associated with our nature is the one established by sensory judgment as temperate. At this point we may well dwell on something fully worth study: the association of original moistness with heat. There is such an unbroken affinity of concord and harmony that they always share their efforts, and neither can do anything without the other's collaboration. For even if a youth has in him in a way as much heat as a boy, he is less significant and strong in the natural tasks than a boy, because with the partial depletion of moistness ["humor"] he has become drier. This plainly indicates that indwelling humor contributes just as much as heat to the natural tasks. But the two are certainly shown to be different by the change that comes on with advancing age: one stays unchanged, while the other is gradually dispersed. It is relevant here that the moistness serves as fuel for the heat, and thanks to it the heat is maintained; the efficient cause being the paramount thing, the moistness serves as material underlying the heat, and has the more passive role. The moistness generally survives in those whose resident heat is suddenly quenched by extreme cold (a fate the northerly gale often inflicts on those traveling through the Alps in winter); what could destroy it [presumably the moistness] so rapidly in abrupt unexpected death? On the other hand, so long as the heat persists, the moistness cannot vanish or be disintegrated. Those who are undone by extreme age meet death by natural necessity, their innate moistness is dispersed along with the heat, so that none (or anyway very little) of it remains, not enough for preserving the heat. The fate of those who die prematurely by drying out through a wasting fever is practically the same.

Vt innatum calidum per anni tempora et per regiones mutetur, et multiplex illius appellatio. Cap. IX.

QUALEM AETATUM decursio affert calidi nostri commutationem, talem existimavit Hippocrates ex anni temporibus nobis obuenire. Etenim hyeme copiosa in nobis substantia caloris affluit: aestate verò dispersa decedit. Hyeme quidem circumsepientis nos aëris frigus corpora contingens, calorem cum sanguine et spiritu, quorum est comes, intrò repellit in profundum, forisque cutis spiracula astringens, caloris substantiam cogit et ita coërcet, vt nihil eius aut minimum possit effluere: sicque illa partibus intimis vires colligens, multò quam priùs robustior euadit. Aestate contrà, quoniam ambientis feruor corporum spiramenta laxat, et interiores tum spiritus tum humores foras elicit, necesse est substantiae caloris plurimum in confinem aërem diffluere atque dissipari, exiguum verò intus contineri. Ver et autumnus istorum moderationem quandam inuehunt. Hunc igitur in modum anni tempora caloris substantiam augent minuúntve. Eius verò qualitatem sic commutant, vt aestas feruentissima exiguam quae in nobis concluditur substantiam torreat ardore, efficiátque vt temperata quae fuerat, naturae metas plerunque excedens, aduentitia reddatur. Hyeme ex frigoris saeuitia substantia caloris nihilo fit frigidior, sed priorem statum retinet iis maximè corporibus quae [P83] plurimo sanguine et calore praedita sunt. Exanguia autem (cuiusmodi eorum sunt animalium quae per hyemem degunt in latibulis) vt omnia frigorum iniuria laeduntur, sic plurima extincto calore de vita decedunt, imò et inter homines vt omnium externae saltem partes refrigescunt, ita quicumque imbecillo sunt corpore, aut sine sensu et motu tanquam delumbati⁵ iacent, aut prorsus ex hominum vita demigrant. Iam verò calidi commutationem quae per anni tempora fit, si quis ei conferat quam aetatum inclinatio protulit: hyemis parte postrema, vt ineunte aetate, vberimum deprehendetur innatum calidum: vere autem eam sortietur conditionem quam in pueritia et adolescentia: aestas proportionem respondet florenti aetati: autumnus ob eam quae aestate fit dispersionem, pauca est substantia caloris, sed ea minùs acris quàm aestate, vnde possit autumnus inclinanti et praecipitatae iam aetati conferri. Sub autumnus finem hyemisque ingressum, calor in nobis modicus inest, qui quoniam corpus etiámtum laxum est et patens, promptè refrigescit, eique non admodum fit dissimilis qui senectutem decrepitam tenuiter fouet. Regionum varietas similis ferè mutationis est occasio. Quanto enim ad austrum et medium illum cingulum qui Solis ardore torretur, magis inclinata est, tanto paucior hominibus inest calidi substantia, ipsa verò qualitas acrior. Contrà quantum regio ad Aquilonem vergit,

Chapter 9. The innate heat alters with the seasons of the year and the region, and has numerous names.

HIPPOCRATES THOUGHT that we encountered the same kind of change of our heat from the seasons of the year that we encounter from the advance of age: in winter we abound in the substance of heat, but in summer it is dispersed away. In winter the cold of the ambient air touches our bodies and drives the heat (along with the blood and spirit that it accompanies) inward to the depths; shrinking the pores of the skin outside, it confines the substance of heat so much that none, or almost none, of it can escape, but it gathers its strength in this way in the inmost parts and turns out much stronger than before. In summer, in contrast, the ambient heat opens up the pores of bodies, and lures out both the spirits and the humors inside. Thus inevitably most of the substance of heat dissipates into the adjacent air, but a little is maintained inside. Spring and autumn bring in some mitigation of these. In this fashion the seasons of the year increase or diminish the substance of heat. And they alter its quality in such a way that the most burning summer bakes with its heat the little substance that is held in us, bringing it about that what had previously been temperate mostly transgresses nature's bounds and becomes extraneous. The ferocity of cold in winter does not make the substance of heat any colder, but it retains its previous position, especially in bodies that possess [P83] a great deal of blood and heat. But bloodless things, such as the animals that pass the winter in dens, are all damaged by cold injury, and so very many of them die from the quenching of their heat; indeed, men too, when at least the outside of them all gets chilled, and if they are feeble of body, either lie without feeling and movement like cripples, or perish entirely. Now if one compares the change of heat that comes with the seasons to the one due to advancing age: in the last part of winter, as at the start of summer, very copious innate heat will be found. In spring it will acquire the state it has in childhood and adolescence; summer corresponds to the prime of life; in autumn the substance of heat is scanty because of its dispersal in summer, but it is less fierce than in summer, so that autumn can be compared to the downward slope of life. When autumn ends and winter starts, there is limited heat in us, and the body being then porous, the heat soon cools, and becomes quite like what gives scanty warmth to decrepit old age. Change of environment is commonly the occasion of a similar alteration. The more the environment faces toward the south and that central belt that is baked by solar heat, the less of the substance of heat is present in people, but the quality is fiercer. Conversely, the closer the environment gets to

tantum in corporibus abundat benéque temperata est innati calidi substantia, nisi fortè cùm ad vltimas terrae regiones acceditur, in quibus prae frigore vix vllum animal hyeme vitam agit. Existit autem hoc loco quaestio subdifficilis, quì fieri possit vt hyeme quàm aestate innatum calidum sit vberius: nunquid fortè tum augetur ea partium solidarum substantia quae olim à semine dimanauit?⁶ Cùm assiduo substantiae fluore corpus nostrum sensim dissoluatur, neque vitare possimus ingenitam nobis senij ac interitus necessitatem, fieri certè non potest quin de propria innati calidi substantia continenter quaedam fiat decessio, non modò maioribus illis aetatum decursionibus, sed et quouis anni tempore tum calido tum frigido. Quanquam enim ambiens aër minùs hyeme quàm aestate dissipat, interior tamen noster calor non minùs pabulum suum populatur et conficit. Quòd si fortè coërcitus intus calor concotionem augeat, et benigni succi copiam exaggeret ad partium nutritionem, instaurétque humidi natiui portionem quae perpetuo illo fluore periit, perspicuum tamen est quicquid accedit instauratione, plurimùm ab eius integritate deficere quod euanuit, quòdque olim fuerat à semine comparatum: alioqui immortale fieret animal. Quò fit vt de innati calidi substantia quotidie magis magisque detrahatur, neque possit vlla hyeme abundantior esse quàm aestate praetergressa: quemadmodum neque florentium aetati potest vel optimis alimentis par ei comparari, quam infantium aetas prae se ferebat. Sed tamen Hippocratis sunt illa. Ventres hyeme et vere natura esse calidissimos, tum verò et magnam innati calidi copiam inesse. Ab hoc igitur medicinae parente cùm nefas sit descuisse, verborum illius vim et bene dicta sic interpretari consilium est: eo loco innatum calidum non eam puram substantiam appellasse, quam solidae partes à semine contraxerunt, et quam aphorismo superiore, crescentium aetati plurimam esse prodiderat: verùm vel eam impuriorem iam factam auctámque vberioris alimenti appulsu, vel omnem substantiam quae moderato et miti calore sit praedita, siue ea pars nostri sit corporis, siue minùs. Hac notione sanguis et arteriarum spiritus ipsáque corporis moles innati calidi substantia sunt: sicuti et eadem naturae appellatione diximus quandoque contineri: qua etiam pubescentibus et adolescentibus plus calidi inesse quàm infantium et puerorum aetati, quiuis rectè censuerit. Veruntamen calidum hoc impurum est, neque innatum idipsum est, quod à prima origine semen nobis indiderat. Itaque naturalis calidi substantia cùm bifariam

the north, the more plentiful and well tempered is the substance of innate heat in bodies, except perhaps on reaching the furthest parts of the earth, where it is so cold that hardly any animal lives there in winter.

At this point a rather difficult question arises: how can it come about that the innate heat is more copious in winter than in summer? Surely what happens is that then the substance of the solid parts increases, substance that once percolated from the seed? Our body disintegrates gradually with the constant flux of substance, and we cannot escape the inborn inevitability of our old age and death; so a kind of continuous decline in the particular substance of the innate heat must certainly come about, not only from those increasing inroads of age, but also from any time of the year, both hot and cold. Although the ambient air disperses it less in winter than in summer, our internal heat plunders and destroys its fuel just as much. But suppose the heat pent up within happens to increase concoction, accumulate a supply of beneficial juice for the nutrition of the parts, and restore the share of innate moistness that has kept on vanishing through that flux. It is still clear that, whatever addition the restoration has made, a great deal is lacking that has vanished from the whole amount, and was originally acquired from the seed; if it were not so, the animal would achieve immortality. Thus it comes about that each day removes more and more of the substance of the innate heat, and it cannot be more abundant in any winter than in the previous summer. Similarly, even with the best of feeding, it cannot be compared at the prime of life with what infancy used to present.

However, here are the views of Hippocrates. Bellies are by nature hottest in winter and spring, the time when a great amount of innate heat is also present.⁶ Therefore, since it is wrong to have defected from the Father of Medicine, my advice is to interpret the well-expressed meaning of his words thus: at that point by "innate heat" he did not mean the pure substance that the solid parts acquired from the seed, and that he had maintained in the previous Aphorism was very plentiful in the stage of growth. He meant either the substance made less pure and augmented by the impact of richer nutriment, or else all the substance that possesses moderate and gentle heat, whether it be a part of our body or [something] less. On this interpretation blood and the spirit in the arteries and the mass of the body itself are the substance of the innate heat, as indeed we said on some occasion that they were included within the name "nature." And on this interpretation, too, anyone would be right to judge that there is more heat in the pubescent and in adolescents than in infants and children. But this is impure heat, not innate heat proper, that the seed instilled in us right at the beginning. And so the substance of natural heat has two

dicatur, aut purior illa partium solidarum à semine ducta, aut ea ipsa nutritione aucta factaque impurior adultis, atque etiam liquidum omne corpus mediocri calore perfusum, siue id sanguis siue spiritus est: fieri quidem haudquaquam potest, vt vna eadémque nominis ratione, crescentium aetas et hyems plurimum habeat innati calidi, sed qui ita pronuntiat, necessariò ὁμωνομίαν inducit.

Natiui tum caloris, tum spiritus differentiae: hósque partibus singulis insitos, aliunde influentibus gubernari. Cap. VII.

[P84] PARTEM UNAMQUANQUE similem innato calido et proprio spiritu instructam esset quoad in vita sit animans, neque citra opem illorum posse vnquam consistere, perspicuum iam est et euidens. Similares partes non vno eodémque omnes temperamento tenentur, sed os frigidius est aridiúsque neruo, neruus vti et membrana carne frigidior atque siccior. Quoniam igitur compositae rei temperamentum ex simplicium quibus constat permistione nascitur, fit necessariò vt eae substantiae quas parti cuique simili datas esse meminimus, diuersam in hac atque in illa parte tum speciem tum substantiam sortitae sint, neque vna temperamenti lex atque modus insit omnibus. Quare qui in osse inest spiritus ab eo distat qui in neruo, hic rursum ab eo qui moderator est carnis. Sic humidum primigenium ipsámque innati caloris substantiam, aliam os adeptum est, aliam neruus, aliam caro, vti et pars vnaquaeque similis. Est autem in his varietas non modò ex substantiae multitudine, sed ex primorum elementorum vnde conditae sunt temperatione profecta. Qui partium functiones studiosè animaduertet, et quòd neque os nerui, neque neruus carnis substantiam gignere possit aut resarcire, neque contrà: hac adductus functionum discrepantia quae illas tota specie discludit, mox opinor causas quae illarum sunt effectrices, pari interuallo disiunget. Hae autem quum sint spiritus et innatum calidum, quibus naturae substantiam compleri diximus, consequens est totidem statui spirituum innatorum, totidem et humidorum et calidorum et naturarum varietates, quot partium similium differentias numero dimetitur, vt vniuscuiusque partis sua haec sint, caeterarum nulli eadem prorsus impertita.

meanings: either the purer substance of the solid parts, derived from the seed; or the substance augmented by nutrition and rendered less pure in adults, and also all the liquid body, whether blood or spirit, imbued with middling heat. It is entirely impossible that the age of growth and winter should have a great deal of innate heat on one and the same interpretation of the word; whoever says so must be employing a homonym.

Chapter 7 [9A]. Distinctions between native heat and spirit; spirits are implanted in individual parts, and controlled by spirits flowing in from elsewhere.

The chapter numbering is anomalous: no chapters 10 and 11 exist. This second chapter numbered 7 appears instead, and for the purposes of this translation is also numbered 9A.

[P84] It is now clear and obvious that so long as an animal survives, each single similar part is provided with innate heat and its own spirit, and an animal cannot come into being without their aid. The similar parts are not all maintained by the same single temperament: bone is colder and drier than nerve, nerve and membrane are colder and drier than flesh. So, since the temperament of a compound thing originates from mixture of the simples that make it up, it must come about that the substances that (as we recall) were given to each similar part have acquired a different form and substance in one part from what they acquired in another, and there is not a standard temperament in them all. Consequently the spirit in bone differs from that in nerve, which again differs from the one in control of flesh. Thus bone and nerve and flesh and every similar part have each acquired a different original moistness and a different actual substance of innate heat. The variety here proceeds not just from the wide range of substance, but from the tempering of the primary elements making them up. Suppose someone studies carefully the functions of the parts, and the fact that bone cannot create or restore the substance of nerve, nor nerve that of flesh, nor vice versa; the functional difference that separates them in their whole form will induce him, I think, to go on to distinguish their effective causes by a similar interval. Since these causes are the spirit and innate heat that we said fill up the substance of nature, it follows that the number of kinds of innate spirits I laid down, and the number of kinds of moistnesses and heats and natures, is the same as the number we determine of distinguishing characteristics of similar parts, so that each part has its own set, and no share at all of any of the others.

Quae partes corporis principatum obtinent, iecur, cor et cerebrum, tum natura, tum spiritu praepotente valent, vt non se ipsis duntaxat gubernandis dent operam, sed alios de se spiritus tanquam iugi de fonte promant, in omne corpus propriis ductibus deriuatos. His quicunque partibus singulis ingeni sunt spiritus, aluntur: his in vires functionesque suas concitati, constantem et perpetuam operum functionem edunt. Vnde intelligitur praeter innatos spiritus qui stabiles et in vnaquaque parte fixi sunt, tres insuper errantes et vagos influentesque existere, vnum naturalem è iecore per venas in corporis extrema diffusum: alterum vitalem quem cor assiduò per arterias emittit: tertium animale qui in cerebri ventriculis genitus, hincque per neruos profectus, partes irrigat sensus motusque compotes. Hunc quidem in cerebri ventriculis viisque sensuum contineri, quemadmodum et in arteriis vitalem, inter omnes medicos iam planè constat: at naturalem ex iocinere proferri, non vsqueadeò est sensu compertum. Caeterum si vis est vlla demonstrationis, neque sunt omnia sensuum testimonio fulcienda, conficient suprà adductae Aristotelis rationes, si qua in iocinere communis et influens statuitur naturalis facultas, illinc quoque naturalem spiritum dimanare, qui eius distribuendae sit vehiculum. Non enim sanguis ad id muneris satis est accommodatus, qui nempe crassior mediam inter corpus facultatémque substantiam non est sortitus. Ergo vniuersum animal gubernant principes tres facultates, totidem spirituum vehiculis, ex suis quaeque fontibus, per proprios canales in omne corpus distributae. Nulla pars in nobis aut calorem aut insitum spiritum, aut vires ab ortu datas potis est retinere citra influentium spirituum vires, sed in breui omnia conciderent à principiorum viribus et fauore destituta. Itaque quum sint partium corporis aliae principes, vt cerebrum, cor, et iecur, adde si videtur et testes: aliae ab his natae et quasi earum viribus subseruientes, vt nerui, arteriae, venae, seminis vasa: reliquarum omnium insitae vires influentibus inde viribus gubernantur: aliae manifestiùs, vt musculus: aliae obscuriùs, vt os, cartilago, vinculum. In has enim partes tametsi neque vena inseritur quae sanguinem, neque arteria quae spiritum perferat, satis tamen haec in illas deriuari declarat assidua quae fit earum nutritio. Neque enim citra influxum possint eae persistere et vita teneri. Nulla igitur seipsa duntaxat gubernatur: nisi id fortassis ita accipiendum quis velit, quòd non per manifestos et [P85] patentes ductus, musculorum et interiorum viscerum modo regatur. Haec siquidem vt vberiores spiritus atque vires acceperunt,

The preeminent parts of the body (liver, heart, and brain) have power from nature and from particularly potent spirit not only to attend to their own control, but also to produce other spirits from themselves, as if from a running spring, that are routed into the whole of the body along their particular channels. These nourish any spirits that are created in the individual parts, and that are roused by them to exert their functions, producing incessant performance. Thus it is seen that there are, besides the innate spirits that are permanently lodged in each part, three more wandering ones that pour in: one is the natural one that is dispersed from the liver along the veins to the limits of the body; another, the vital one continuously ejected by the heart through the arteries; and a third, the animal one, generated in the cerebral ventricles, that travels from there through the nerves to refresh the parts with sensory and motor powers. All physicians are now in complete agreement that this resides in the cerebral ventricles and sensory pathways, just as the vital spirit resides in the arteries. But it has not been so firmly established by the senses that the natural one is produced from the liver. However, if an explanation has any force, and there are things that do not depend on the witness of the senses, Aristotle's reasoning (mentioned above) will establish that if there is a general natural faculty flowing in and settled in the liver, it is from there that the natural spirit emanates, being the carrier for distributing the faculty. Blood is unsuited to this task; being rather thick, it does not possess a substance intermediate between body and faculty. Accordingly, three main faculties control the whole animal, distributed throughout the body along their own channels, each from its own springs, by the same number of spirits as carriers. There is no part in us capable of keeping its heat or resident spirit or the powers given to it from the start, except by the powers of the spirits flowing in; everything would rapidly collapse through lack of the powers and goodwill of the principles. So since among the parts of the body some are main, like brain, heart, and liver (include testicles if you wish), and others are derived from them and (as it were) in support of their powers (like nerves, arteries, veins, seminal vessels), the resident powers of all the rest are controlled by powers flowing in from these: some more obviously, like muscle; others less so, like bone, cartilage, ligament. Even though no vein runs into these parts to convey blood, nor artery to convey spirit, the continuous nourishment they get shows that enough is passed on to them. They could not continue alive without inflow. So none is controlled by itself alone, unless perhaps someone wants an instance accepted that is not regulated through obvious open channels, like muscles and the insides of viscera. [P85] Although muscles and the insides of viscera possess quite plentiful spirits and powers, they

sic venis, arteriis atque nervis indigent, quibus manifesta sit et conspicua gubernatio. Ex his denuò planum fit et apertum, tum vitalem, tum naturalem spiritum in omne corpus effundi atque diffluere, eoque pertingere vbi neque vena, neque arteria est: harum enim adminiculo non vbique indiget: animalem autem spiritum nusquam posse citra nervos aut eorum villos atque stamina contineri, aut vires suas prodere. Optima id quidem ratione à natura institutum, quòd pars vnaquaeque nutritione et vita, non autem sensu et motu indigeret.

Naturalem spiritum fieri materiem vitalis atque animalis: utque spiritus et aliae substantiae partibus ingenuitae alantur. Cap. XII.

HAC AUTEM ratione insiti spiritus, et aliae solidarum partium substantiae seruari nutritique solent. Alimenti purior magisque aërea portio, concoctione in eam transit sanguinis tenuiorem substantiam, quae vaporis speciem quandam exhibet. Ea tùm à spiritu iecori ingenito vim accipiens, eiusque vbertate penitus perfusa, spiritus fit naturalis, reliquo sanguine tantò praestantior, quantò iecoris molem vis ei naturaliter insita praecellit. Huius spiritus quantum per venam cauam vnà cum sanguine effertur, et in cor inuehitur, illic denuò caloris vi accuratiùs elaboratum attenuatùmque, in aëris propè speciem mutatur: atque ex dextro cordis sinu per communes eòsque arctissimos aditus, in sinistrum sinum viam capessit et permeat, vbi hausto per pulmones aëre temperatum, materia quaedam fit cui calor et vis concessa vitalis, spiritum profert vitalem per arterias toto corpore diffusum atque consertum. Quae portio istius per ceruicis arterias in cerebri basin rapitur, tertio contextus illius admirabilis anfractu mitigata, mox in cerebri ventriculos per contextum alium choroidem appellatum confertur. Illic ex hausto per nares elaboratòque aëre, fomentum incrementùmque recipit, et vi proprietatèque spiritus qui cerebro est ingenuitus, conuersione quadam spiritus fit animalis, aethera planè imitatus, ad motum, ad sensum, ad omnes denique animales functiones aptè comparatus. Itaque vapor ille sanguinis in iocinere natus, si vitali spiritui, deinde et animali sese materiam et quasi alimentum exhibet, debet primo statim spirituum ordine collocari. Quantum hic à vitali, tantundem profecto et vitalis ab animali tenuitate differt: etenim naturalis, vaporem aemulatur, vitalis aëreus est, animalis

lack veins, arteries, and nerves to provide obvious control. Once more: this makes it perfectly clear that both vital spirit and natural spirit are emitted into the whole of the body and disperse, thus reaching where there is neither vein nor artery, for no part of the body lacks their aid. But animal spirit cannot be maintained or extend its powers anywhere beyond the nerves or their filaments and threads. This arrangement by nature is soundly based, because each part would require nutrition and life, but not sensation and movement.⁷

Chapter 12. Natural spirit becomes the material of vital and animal spirit. How the spirits and other substances inherent in the parts are nourished.

THE RESIDENT spirits and other substances of solid parts are usually preserved and nourished on the following basis. The purer and more airy part of the nutriment crosses in concoction into the more rarefied substance of blood, which presents some appearance of a vapor. This acquires power from the spirit inherent in the liver, and when thoroughly imbued with its richness, becomes natural spirit, excelling the rest of the blood as much as the power naturally situated in the liver surpasses the liver's bulk. The amount of this spirit that is carried through the vena cava along with the blood and into the heart is perfected and thinned again more precisely by the power of heat, and changed practically to the form of air; from the right chamber of the heart it penetrates into the left one through very narrow shared passages. There, tempered by air drawn in through the lungs, it becomes a material that, provided with vital heat and power, sends forth vital spirit through the arteries that is dispersed and closely packed in the whole body.

The part of this that sweeps through the cervical arteries into the base of the brain⁸ is modified for a third time⁹ by the bend of the well-known marvelous structure,¹⁰ and next enters the cerebral ventricles through the other structure called the choroid [plexus]. There it receives fuel and an increase from the air drawn in through the nostrils and perfected; and through the particular power of the spirit inborn in the brain, it undergoes a sort of change to animal spirit, clearly mimicking the ether, and well adapted for movement, sensation, and indeed all the animal functions. So if the celebrated vapor of blood, formed in the liver, later furnishes itself as material and nourishment for vital spirit, and then for animal spirit, it should automatically be placed in the first rank of spirits. In its degree of rarefaction it differs as much from vital spirit as vital does from animal; for natural spirit emulates a vapor, vital spirit is airy, but animal

autem aethereus. Vitalem peraequè ac animale, si spiritum dicimus, quid non pariter naturalem eadem appellatione notemus? Quae in substantia spirituum varietas inest, efficit quidem vt non vnus eiusdémque ij sint naturae: at genus vnum communémque appellationem eos participare quid quaeso obstabit? De his quidem ita sit statutum. Qui naturalis spiritus et appellatus, supra reliquos hoc peculiari munere praeditus est, vt quum propriae facultati se vehiculum exhibuerit, alimentum deinde se offerat ei alendo spiritui, qui suus est cuique parti similari congenitus. Ita enim conuenit vnamquamque huius substantiam conuenienti atque idoneo foueri alimento. In eo porrò humore qui per ora venarum in partium vacuas regiones tanquam ros aliquis confluit, quicquid crassius et concretum magis est, id solidae substantiae crassamentum, in alimentum sibi allicit atque iungit: quicquid autem tenuius est, et olei cuiusdam particeps, humidum illud primigenium fouet et alit: vapor illinc sublatus vnà cum naturali spiritu, ingenitum partis cuiusque spiritum continet, simul verò et circumfundentis nos aëris per diastolen⁷ transmissio. Reliqua quaecunque similari parti insidet substantia, id sibi allicit reponítque in alimentum, quod in affluente humore medium est inter vaporem et crassiorem substantiam. Itaque particulae toti similari alendae vnus sanguis sufficit: sed cuius singula conuenientibus earum singulis accommodantur, vt suo posthac loco plenius afferetur.

QUARTI LIBRI DE SPIRITIBUS ET INNATO CALIDO
FINIS.

spirit is ethereal. If we use the name “spirit” of vital spirit just as of animal spirit, is there any reason not to use it equally of natural spirit? The variety that exists in the substance of spirits means that these are not two natures belonging to one and the same thing; but what, tell me, will prevent them sharing one kind and a common name? Let that be the decision about them. What actually goes by the name of natural spirit possesses this special function beyond the rest, that when it has presented itself as transport for its own faculty, it goes on to offer itself as nutriment to feed the spirit that has come into being as particular spirit for each similar part; it is appropriate for each substance of it to be nurtured by appropriate nutriment. Again, the humor that has run like some dew through the mouths of the veins into the voids of the parts entices and attaches as food for itself whatever is thicker and more congealed, the sediment of solid substance. But the more rarefied component, which has a share of an oil, fosters and feeds the original moistness mentioned already; the vapor that rises from it along with natural spirit holds the spirit inherent in each part, and so does the passage of the air surrounding us in the course of dilatation [presumably of the chest]. Any substance remaining in a similar part entices to itself and stores as food the component in humor flowing in that is intermediate between vapor and thicker substance. And so blood alone is enough for the nourishment of the whole of a similar part, but the blood’s individual features are adapted to suitable individual features of the similar parts, as will be put forward later more fully in the proper place.



DE ANIMAE FACULTATIBUS. LIB. V.

Quid anima. Cap. I.

[P86] TERRENO CONCRETÓQUE corpori quicquid finitimum natura nobis ingenuit, quicquid affine in vnum quasi concentum nexuit, siue aspectabile, siue abstrusum id et sensibus incompertum foret: sic omne superior commentatio explicauit, vt nihil insuper desyderari [*sic*, as in 1542] posse confidam, quod eius fabricationem et structuram plenius adornet. At quoniam non in solius corporis, sed in hominis qui ex corpore et animo constat, meditatione versamur, quum ad exitum iam perducta sit corporis tractatio, nunc animi eiúsque partium et facultatum contemplatio iure adeunda videatur, si quidem vllum est studium percipiendi hominis atque cognoscendi. Inuoluta nimis et obscura animae cognitio, et quam ceu minús obuiam non sit promptum attingere. Quocircà sensus nostros effugientem illam, solis functionibus operibúsque proditis, cernere mens possit: vti et vnamquamque reconditam causam ex affectibus qui conspicui sint et obiecti sensibus, ea solet excutere. Itaque dum in viuus est homo, plurima munera exequitur, quae morte consumptus ne minimum quidem attigerit: quod argumentum sanè est horum munerum non corpus ipsum efficientem causam haberi, sed inesse quippiam viuenti quo sit is praestantior atque potentior demortuo, et quo ad obeunda munia se comparet. Inest quidem in homine quaedam actionumabilitas et efficientia, ipsa denique vita quae propria quaedam est viuientis functio: verùm actionem veterum philosophorum imitatione animam censere, quae dormientibus nobis extra corpus diuagetur, vigilantibus in id remeet, nisi fortè immodico sopore longiùs profecta remigrare non possit, anile sanè et plenum superstitionis est. Quare quum sint actiones in eorum accidentium genere quae continenter abeunt prolabanturque, quemadmodum et motus omnis, neque à seipsis vnquam firmè subsistant: necessarium est quoties actiones obiri cernimus, superiorem his causam mente complecti, quam illae velut vmbra corpus consequantur. Ergo actionum vitae stabilis et constans quaedam in nobis est causa, qua praesente vita actióque omnis perficitur, qua decedente simul vita perit



BOOK 5

THE FACULTIES OF THE SOUL

Chapter 1. The soul.

[P86] EVERYTHING THAT nature has implanted in us that is closely allied to an earthly composite body, everything related that she has bound into one harmony (so to speak), whether visible, or hidden and beyond sensory detection: the above account has set it all out, in such a way that I believe nothing more could be required for a more complete embellishment of its architecture. But we are contemplating not just the body, but man, who comprises body and mind; and so, as the account of the body has now been brought to completion, it seems the right moment to set about considering the mind and its parts and faculties, if we have any concern to acquire a knowledge of man. Knowledge of the soul is too darkly veiled, and being less accessible is hard to achieve. It evades our senses, so that the mind can perceive it only as its functions and operations are revealed, just as it usually discovers each occult cause from effects that are presented visibly to the senses. And so, as long as a man lives, he performs very many tasks that he will not achieve at all after death; this certainly demonstrates that the body itself does not constitute the efficient cause of these functions, but there is something in the living body that makes it more excellent and powerful than a dead one, and able to gather itself for performing tasks. There resides in man a sort of aptitude and efficient power for action, as does life itself, that is the special function of the living. But the opinion, following ancient philosophers, that the soul is action, and wanders about outside the body while we sleep, returning to it on our waking, except maybe if it goes off too far in excessive slumber to be able to return: this opinion is an old wives' tale, and full of superstition. So since actions are of the kind of accidents that continually depart and slip away, like all movement, and never have a stable existence of their own, our mind must grasp a higher cause for actions, a cause they follow as a shadow follows a body, whenever we find them being performed. There is therefore in us a permanent cause of the actions of life; when it is there, life and every action go on, and when it departs, life ends and is

atque dissipatur. hanc [lower case H; surprisingly, the same in 1542 and 1554] tantisper dum nequeunt aliter illius essentiam cognitam habere, omnes quidem animam esse profitentur: vt sit anima principium et causa functionum viuentis corporis. Nihil verò refert si quis organici corporis perfectionem esse statuatur: quod enim viuens est corpus, id continuò naturale est et organicum. Nam quatenus viuit, alimento sanè vtitur, organáque adeptum est tum ad concoctionem, tum ad alimenti distributionem accommodata, sine quibus neque alimento vti possit, neque viuere. Ergo quum viuens omne corpus statim sit organicum, quicquid illi vitam conferet actionésque vitales inducet, anima censeatur: ea autem totius est perfectio.

Animae genera, partes et facultates quot et quae sint. Cap. II.

VIUENTIS CORPORIS species est anima, cui vita tanquam propria peculiarisque actio comes est et socia. Cuicumque igitur illa insidebit, id animatum reddet pariter et viuum, animámque sortietur ceu veram essentiam, vitam verò vt propriam illius functionem. Vnde exquisita animatorum ab inanimis differentia per animam et animatorum ordines ex animae differentiis verè decernuntur. At nihilominus quoniam plerunque relictæ essentiae obscuritate, ad eius proprias functiones quae manifestiores sunt diuertimus, idcirco ex his plerunque differentias rectè nobis comparamus. Sic philosophi praestantissimi et animam vitam definierunt, et ex vitae differentiis animae genera protulerunt. Quos et nos hîc sequuti, ab infimo viuentium ordine per singulos gradus [P87] ad hominis vsque naturam progressionem facta, ex vitae functionibus, quòd alia corpora solius naturae beneficio viuant quae φύτα, id est terra edita dicuntur, alia sentiant, alia ratione et intelligentia praedita sint, tres viuentium differentias mente complectimur, naturale, sentiens, et intelligens: tres quoque animae species iisdem nominibus insignitas, quae sunt naturalis, sentiens, et intelligens: quibus haec respondent viuentium genera, φύτον, id est terra editum siue stirps, brutum, homo. Etenim propriè illa inferiorum generum conditionem subeunt, quòd disclusa disiunctaque separatim subsistant, quòd nunquam in idem coire conciliarique possint: quòdque sigillatim de vnoquoque animae nomen enuncietur. Quae enim in satis ac stirpibus naturalis inest, ea sanè est anima, à qua et stirpes animatas, dicimus, licet nondum animalia: quae item beluis praeest sentiens ea quoque anima est, quae non animatas modò,

dispersed at that time. So long as they cannot consider its essence as known any other way, this is what everyone declares the soul is: it is the origin and cause of the functions of the living body. It makes no difference if anyone considers it the perfection of an organic body; a living body is necessarily natural and organic. For insofar as it is alive, it certainly makes use of nourishment, and possesses organs suited both to concoction and to the distribution of nutriment. Without them it can neither make use of nourishment nor survive. Therefore, as a living body is organic from the start, anything that endows it with life and evokes vital activity should be considered the soul; it is the completion of it all.

Chapter 2. The number and nature of the kinds, parts and faculties of the soul.

THE FORM of a living body is the soul, and life is the soul's companion and associate, being its particular activity. So anything the soul comes to inhabit will be made equally animate and alive, and acquire soul as its true essence, and life as its particular function. Hence precise distinguishing characteristics between what is animate and what is inanimate are correctly discriminated from distinguishing characteristics of soul by reference to the soul and the grades of animate creatures. Still, since as a rule we set aside the obscurity of the essence and turn to its more obvious specific functions, we do right to get from them as a rule our distinguishing characteristics. The most notable of philosophers have defined the soul by life, and derived the kinds of soul from the distinguishing characteristics of life. We too have followed them in this, and advanced step by step from the lowest grade of living creatures [P87] up to human nature in terms of vital functions: there being some bodies that are alive thanks to nature alone (the plants, so called because brought forth by the earth); others possessing feeling; others endowed with reason and intelligence. So we grasp three distinguishing characteristics of living creatures: the natural, the sentient, and the intelligent. There are also three forms of soul indicated by the same names: natural, sentient, and intelligent. There are corresponding kinds of living thing: phyton (brought from the earth, or plant), brute, and man. Individually, these properly assume the character of inferior kinds, because they exist in separate independence and can never be united into one; also because the name "soul" is uttered separately in reference to each.

The natural one, which resides in crops and plants, is clearly soul, which makes us call even plants animate, though they are not yet animals. Similarly, the feeling entity preeminent in beasts is soul too, which makes them not just

sed etiam animalia illas efficit. Intelligentem demum hominis mentem nemo fuerit qui animam esse non dicat. Sic autem seiugatae sunt atque distractae, vt neque quae hominis intelligens est anima sit sentiens, neque quae beluis sentiens imperat, sit naturalis, vt neque homo belua est, neque belua stirps, alioqui in magnam confusionem adigerentur rerum species. Quinimò eidem nequeunt pariter insidere intelligens et sentiens, vel sentiens et naturalis: quoniam neque complures substantiarum formae, reuera eiusdem esse possunt subiectae materiae, neque idem liceat beluam et fruticem appellare, neque beluam et hominem. Haec igitur tria sint discreta animae genera. Efficit autem nominum inopia, vt iisdem quoque appellationibus tum partes, tum facultates animae designentur: vnde permagnis saepe obscuritatibus scripta latent inuoluta. Ita enim quicquid intelligens est, continuò sentiens esse dicimus, id est sentiendi facultate praeditum, et quod sentiens est, id quoque fatemur naturae facultatibus teneri: vt haec non principum formarum, sed vel partium, vel facultatum sint nomina. Partes animae eas dici velim, quae sociatae atque connexae, in totius vnam et integram substantiam conspirant, quibus seorsum singulis non aptè potest totius nomen accommodari. Quae tria modò ante oculos posuimus, intelligens, sentiens, et naturale, in homine quodammodo comprehenduntur, vt partes sunt animae, non autem vt genera: eadem disclusa sedibus, genera constituunt. Animae partes geometricis figuris rectè visus est Aristoteles contulisse. Inter has primus est trigonus, qui neque ex aliis se prioribus constat, neque ab angulo in angulum alterum, exporrecta linea diuidi potest. Secundus ab hoc est tetragonus, qui trigonum potestate concludit: vt pentagonus tetragonum atque trigonum. Vt igitur in pentagono qui simplex est figura, trigonus et tetragonus vt partes insunt, potestate duntaxat non reipsa (neque enim illic trigonum neque tetragonum, sed pentagonum duntaxat figurae nomen et rationem habere dicimus, alioqui non simplex esset, sed iam ex compluribus composita figura) sic procul dubio intelligentem animam homini simplicem inesse statuendum est, cuius partes sint sentiens ac naturalis, non hae quidem energia, sed potestate duntaxat consistentes. Ea est partium animae ratio. Appetens verò, cogitatione fingens, et ad locum mouens, neque genera, neque partes sunt animae, sed vnius eiusdémque partis facultates, eius nempe quae sentiens appellatur. Haec non animantium ordines atque gradus secernunt, vt quaedam sentiant quae loco nequaquam mouentur: sed adeò inter se connexa sunt et apta, vt dissolui nunquam possint, et cuique animanti vniuersa pariter inhaerescant. Omnium quippe animantium tactus saltem est communis:

animate but animals too. Lastly, everyone will always call the intelligent human mind a soul. Souls are so distinct that the intelligent human mind is not sentient, nor is the sentient soul that rules beasts natural; a man is not a beast, nor a beast a plant, otherwise the forms of things would be reduced to extreme confusion. Further, the intelligent and the sentient cannot coexist in the same thing, nor the sentient and the natural, since several forms of substances cannot really underlie the same material, nor can a beast and a bush, or a beast and a man, have the same name. So let us have these three separate kinds of soul. Scarcity of words makes both the parts and the faculties of the soul go under the same names; hence writings are often wrapped in profound obscurity. For instance, whatever is intelligent we immediately say is sentient (that is, endowed with the faculty of feeling), and what is sentient, we acknowledge is also inhabited by the natural faculties. And so these are not the names of original forms, but either of parts or of faculties. I would like the name "parts of the soul" to refer to those that unite and bond in harmony into a single entire substance of the whole, and the name of the whole cannot properly be applied to one of them separately. The three we have just gazed upon, the intelligent, the sentient, and the natural, are contained somehow in a man as parts of the soul, but not as kinds of it; taken out of their places, they form kinds. Aristotle appears to have been right to compare the parts of the soul to geometrical shapes. The first of these is the triangle, which does not consist of others that precede it, nor can be split by a line extended from one angle to another. The quadrilateral comes next, which includes the triangle in its jurisdiction, as the pentagon includes the triangle and the quadrilateral. The triangle and the quadrilateral lie within the pentagon (a simple shape) as parts of it in potentiality alone, not in reality; we do not say there that the name and description of the shape belong to the triangle or to the quadrilateral, but to the pentagon alone, which would otherwise not be simple, but a shape already made up from several others. In the same way, it must be declared that undoubtedly the intelligent soul in man is simple, the sentient and natural to be parts of it, but present only in potentiality, not in actuality. This is the theory of the parts of the soul.

But appetite, imagination, and the initiation of movement are neither kinds nor parts of the soul, but faculties of one and the same part of it: the part called sentient. The ranks and grades of living things do not differentiate these, to make some sentient that do not move about at all, but they are so closely linked and associated as to be inseparable, and they all come to dwell together in each animal. Indeed, in animals the sense of touch at any rate is universal; everything

hoc autem primo sensu quicquid praeditum est, statim voluptatis atque doloris est particeps, potestque pestifera à salutaribus discernere, et quodam desiderio ad res salutes accedere: unde fit ut quicquid sensu illo praeditum est, id illico appetitu quodam ornatum esse videatur. Quum autem res salutaris sensu percepta in communem sensum referetur, tum orietur voluptatis et eximiae delectationis comprehensio, haec verò deinde appetitum concitabit: sic comprehensione et appetitu impulsum animal eo trahitur moueturque ut optata consequatur et teneat. Quò fit ut quae pars animae sensu pollet, eadem pariter et phantasiae et appetitus et motus facultates habeat. Itaque non modò perfectiora animantia, sed et muscae et vermes et vniuersum insectorum genus, quinetiam ostreae et conchylia et spongiae et quae inter frutices et ani-[P88] malia ambigunt, ζωόφυτα Graecis appellantur, plantanimes à quibusdam dici coeperunt: hae tametsi sede stabili vitam degunt, compuncta tamen in sese coguntur, diffunduntur verò laetorum occursum: inditium sanè quòd tum motu, tum sensu valent et praedita sunt. Caeterum ut in illis sensus appetitusque plurimum obscurus inest, ita et motus incertus atque confusus: ut hac ratione nonnunquam censuerit Aristoteles motu illa priuari, et eorum quae sentiunt quaedam loco moueri, quaedam non moueri. Quocirca appetens, cogitatione fingens, et ad locum mouens, nequaquam noua quaedam animae genera constituunt, sed quum sentienti ea semper insint et assideant, in idipsum genus pertinent, cuius vires et facultates rectè dici possint. Est enim facultas vis illa et potestas quam anima tanquam de sinu suo promit, et ad munus functiones profert. Id autem perinde est atque si dixeris insitam et vernaculam animae proprietatem: quae ipsa quidem est accidens, sed animae intimum atque adeò intestinum, ut plerisque illius essentia putetur. Hinc non rarò vnaquaeque pars animae, facultatis appellatione describitur. At cui exquisita nominum rerumque notio curae fuerit, is non essentiae animae, sed viribus quae ab illa dimanant, facultatis nomen aptabit. Quotidianus quidem vsus licet opera facultatibus referat accepta, ea tamen primum ab animae substantia emanare censemus, quae unà facultates ad opus impellit. Vna siquidem animae substantia multis facultatibus et viribus se fundit atque ostendit: haud secus ac pomum, quod reuera vnum varias spargit qualitates, odorem, speciem, et colorem. Magnes lapis vim obtinuit, qua ad coeli se vertices conuertit aspectumque refert, vim aliam qua ferrum

that possesses this primary sense automatically gets its share of pleasure and pain, and can distinguish the harmful from the wholesome, and make for the wholesome with some eagerness. This is how it comes about that whatever is endowed with any power of sensation is found on the spot to possess some appetite. When something wholesome is apparent to sense and is brought to the general sensory capacity,¹ then a perception of pleasure and special gratification will arise, which will then arouse appetite. In this way, driven by perception and appetite, an animal is drawn to seek and grasp what it wanted. Consequently the part of the soul that predominates in sensation is the one that possesses the faculties of imagination, appetite, and movement equally. And so it is not just the more perfect animals, but also flies, worms, the whole kind of insects, and also oysters and molluscs and sponges and the intermediates between bushes and [P88] animals that the Greeks call zoophytes and some people have started calling plant-animals; these do spend their lives on a fixed base, but contract if pricked, and spread out if something welcome approaches: evidence clearly that they possess the advantages of movement and sensation. But while sensation and appetite are present in them in a very obscure fashion, their motion is hesitant and disorderly. For this reason Aristotle sometimes considered that they lacked [the power of] movement, and that of those that could feel, some changed their position and others did not. Hence appetite, imagination, and the making of movement do not amount at all to new kinds of soul, but as they are always present in the sentient soul, they belong to that particular kind of which they can rightly be called powers and faculties; a faculty is the power and potentiality that the soul brings out from (so to speak) its bosom, and presents for the performance of functions. It [i.e., the logic of it] is just as if you referred to an indwelling and homegrown property of the soul, which is itself an accident [in the philosophical sense], but so deep within the soul that most people would take it for the soul's essence. This is why quite often each part of the soul is described by the name "faculty." But anyone with a concern for the most refined acquaintance with names and things will fit the name "faculty" not to the essence of the soul, but to the powers that percolate from it. Everyday use may well attribute activities that are under consideration to faculties, but we believe they proceed originally from the substance of the soul, which urges the faculties at the same time to the activity. Suppose a single substance of the soul distributes and displays itself by many faculties and powers: an apple is the same, and though really single, scatters diverse qualities: perfume, appearance, and color. A magnet has acquired a power by which it turns its face toward the heights of heaven, and another by which it attracts iron

ad se prolectat. Aloë vim et facultatem habet purgandi, ventrem corroborandi, vulnera conglutinandi, et obducendae cicatricis. Itaque dum vna animae essentia complura de se profert opera, varias in haec facultates accommodat, vt sit sua cuiusque operis facultas, neque sint vnus et eiusdem facultatis opera diuersa. Vnde quum par sit operum atque facultatum numerus, ex illorum differentiis harum quoque differentias liceat numerando percensere. Ergo cùm vnus cuiusque quatenus vnum est et vno modo se gerit, vnicus sit motus: si anima quae simplex est substantia, aliis aliisque motibus varia efficit opera, varias quoque in haec vires facultatésque tanquam instrumenta confert: quibus multifariam se exhibens diuersos promit effectus. Has autem facultates neque animae substantiam, neque eius vllam partem esse inde intelligitur, quòd illae nonnunquam exolescunt atque pereunt integra superstite animae essentia. Etenim vis et facultas augescendi post vigorem annis confirmatum intercidit et aboletur, quaeque viridi aeuo constans fuerat, exitum certum habet in aetate, tametsi eadem superest animae substantia. Quinetiam nullo seminis concursu, sed quadam putrida colluue quaecunque vlrò suáque sponte prognata sunt: quaecunque collatis perfusisque diuersorum generum seminibus emergerunt, vt mulus, vt leopardus: quanquam anima continentur sentiente, facultatis tamen gignendi sunt expertia: siquod ab eis semen editur, sterile id toto genere est ac minimè foecundum. Ex quibus perspicuum est facultatem ab animae parte hoc potissimum distare, quod illa possit ab animae substantia seiungi atque discludi, pars nulla queat separari quin tota simul anima disperdita soluatur. Facultas quamuis ingenita sit animae, tamen accidit et inhaeret: pars animae substantia est et quaedam illius ceu portio. Haec seorsum constituta aut in stirpibus aut in beluis subsistit, illa disiecta nunquam consistit citra animae ex qua pendet adhaesionem.

*Quot primae partis animae sint facultates, quae naturales
appellantur. Cap. III.*

QUONIAM IGITUR facultates ex operibus internosci, et ex horum multitudine illarum numerum animaduerti proditum est: quot vnus cuiusque partis animae facultates sunt, quot earum differentiae, nullo negotio potest recenseri. Opus vnunquodque effectione quadam completur, et in lucem prodit: eaque effectio motio

to itself. The aloe possesses the power and faculty of purging, of strengthening the belly, of sticking wounds together, and contracting the scar.² So, while a single essence of the soul is bringing several activities into being of itself, it applies various faculties to these, so that each activity gets its own faculty, and one and the same faculty is not responsible for diverse activities. Hence, since the number of activities is the same as the number of faculties, one can enumerate the distinguishing characteristics of the latter from those of the former. Thus each one has a single motion so far as it is single and behaves in a single fashion; consequently if the soul (a simple substance) performs various activities by other substances and motions, for these it brings to bear various powers and faculties as its instruments; by them it displays its many sides as it delivers various effects. It does not follow from this that these faculties are the substance of the soul, or any part of it, because they sometimes die out while the soul's essence survives intact. After vigor has become established with the years, the power and faculty of growth passes away, and what had been permanent in the prime of life meets its inevitable demise in old age, even though the soul's substance survives. In addition, [consider] anything that has come into existence spontaneously from some rotting refuse, without any conjunction of seed; and anything, such as the mule or the leopard,³ that has come forth by promiscuous association of seeds of different kinds ["genera"]. These are associated with a sentient soul, but lack the faculty of procreating; if they produce any seed, it is sterile in its whole kind and barely fertile. This makes it clear that a faculty differs from a part of the soul particularly in its ability to be parted from the substance of the soul; no part could be separated without the total breakdown and destruction of the soul at the time. Though a faculty is implanted in the soul, it is as an inherent accident [in the philosophical sense]. A part of the soul is a substance, and as it were a share of it; it exists separately established in plants or beasts. But a faculty never exists in isolation and apart from the attachment to the soul it depends on.

Chapter 3. How many faculties there are of the first part of the soul, the so-called natural faculties.

IT IS our task, then, to distinguish the faculties by reference to their activities, and to recognize the number of faculties from the number of activities; yet no amount of pains can review the number of the faculties of each separate part of the soul, and of their distinguishing characteristics. Each single activity is fulfilled and brought to light by some effect, and this effect is a motion of an

est efficientis. Efficiens igitur quippiam id praecurrat necessum est, aut fortasse complura, quorum tamen vnum statuatur tanquam primaria aut princeps causa. Huiusmodi est anima quae quum inter omnia quae in [P89] nobis sunt vi et efficientia praestet, propriis facultatibus quasi causis adiuvantibus et instrumentis tum corporeis, tum incorporeis vtitur ad omnia quaecunque obit. Facultates autem proximae et continentes operum sunt causae, quarum observationem atque cognitionem satis supérque medico sufficere plerique censuerunt: in earum igitur inuestigationem nobis est diligentius incumbendum. Partium animae omnium ea prima statuitur quae omnium viuientium communis, natura et animae pars naturalis dicta, sola stirpes regit atque moderatur. Huius gestiones tres vt et tria opera cernimus in omni tum stirpium, tum animantium genere, quae defecta non sunt et oblaesa vt mulus: eae sunt, procreatio, nutritio et accretio: opera autem sunt stirps surgens è semine, aut qui vtero geritur foetus ac fingitur: augescens stirps aut animal: hoc saluum et vita conseruatum. Tres praesunt illis effectrices facultates, procreatrix, altrix et quae auctrix appellatur. Quo tempore foetum gestat foemina, omnes tametsi in commune idémque opus conspirant, procreatrix tamen illa vis dominatum habet: edito iam partu ea languescit móxque aboletur vt dentes emiserit, quúmque ab editione nulla iam pars gigni videatur, dentium duntaxat gignendorum gratia haec manet incolumis: deinde augendi facultas viget, dum ad magnitudinis constitutum certúmque modum hunc prouexerit. Quod reliquum est vitae tempus, in solius altricis est potestate: quae cum vitae totius sit comes et conseruatric, primis illa vitae aetatibus aliarum duntaxat erat administra et auxiliaria: vt in vtero ea quae ad augendum valet, procreatrici subsidio venit atque suffragatur. Itaque prima seminis natura ab initio tribus illis est instructa facultatibus, quas inde naturales appellarunt. Hae sunt vnus eiusdémque partis animae multae vires, quae propriis se operibus exuscitant et expromunt. Si foetus vtero gestatus tribus illis continetur, editus verò dum adoleuerit duabus, reliquo vitae curriculo vnica, quónam illae auolarunt? perierúntne prorsus an illic praeterea ignauae iacent et quasi feriatæ? Persistit vna quidem facultatum substantia in diem vitae supremum, neque à suis illa viribus manet destituta: quorsum enim genito iam animali eóque edito debeat procreandi vis perire? quid illam sustulerit? Verùm¹ quoniam prima illa seminis natura quò vires suas exprimat, idoneo corporis

efficient [cause], and so the activity has to be preceded by one, or perhaps by several, but one is to be established as the primary or principal cause. The soul is [a primary cause] like this; since in its power and effectiveness [P89] it excels all that is in us, it employs for everything it undertakes its own faculties (assistant causes, as it were) and instruments both corporeal and incorporeal. Faculties are the proximate and adjacent causes of activities, and most people have held that their observation and study is enough and more than enough for the physician. So we must devote ourselves more diligently to their investigation.

Of all the parts of the soul, the one set down as the first is the one common to all living things, called nature and the natural part of the soul, which on its own controls plants. We see its three performances and three activities in every kind of plants and of animals (if not impaired like the mule); they [the performances, evidently] are procreation, nutrition and increase. The activities are the plant rising from the seed, or the fetus carried in the womb and being shaped; the plant or animal growing; it being preserved in life. Three effecting faculties control these: the procreative, the nourishing, and the one called the increaser. While a woman is carrying a fetus, they all collaborate, so to speak, in one common task, but the procreative power has the whip hand. Once the baby is out, this power flags, and presently vanishes when it has put forth the teeth; it remains in being just to generate the teeth, as no [other] part seems to be generated after birth. Next the faculty of growth thrives, until the established limit of size has been reached. The rest of the life span is in the power of the nourishing faculty alone. Though it is the companion and preserver of the whole of life, in the early years it is just the manager and aide of the others; similarly, in the womb the faculty that influences growth lends its aid to the procreative one.

And so the seed's original nature is provided from the start with these three faculties, which have therefore been called natural [faculties]. They are the numerous powers of one and the same part of the soul, which rouse and reveal themselves by their own activities. Suppose the fetus in the womb is sustained by these three, but after birth up until the end of adolescence by two, and in the rest of the life span by only one: where have they flown off to? Will they have perished entirely, or are they lying there in addition, idling on holiday? Does a single substance of the faculties survive to the last day of life, still in possession of its powers? When an animal has been brought into being and born, at what point should the power of procreation come to an end? What will sustain it? But the original nature of the seed requires the appropriate aid of some body

alicuius et caloris adminiculo indiget, citra cuius opem ne minimum quicquam efficere potest: quum certè aut mutila erit et violata corporis integritas, aut ad effectiorem materia deficiet, tum illa vacabit finèmq̃ue constituet operi. Vt igitur magnetem alio perunctum quia ferrum allicere non potest, trahendi facultate orbatum dicimus aut saltem praepeditum: et cui suffusio oculi aciem perstringit, is obcaecatus dicitur, eíque adempta cernendi facultas aut certè impedita: ita et qui senio confectus effoetum corpus et emeritum adeptus est, augescendi aut partes nouas gignendi facultatem non habet: et quae in illo est naturalis pars animae, si fortè illaesa statuitur, intercepta tamen est et corporis vitiis irretita. Iam verò quae et quot singulis naturalibus facultatibus subsint partes, excutiendum explicandúmque est. Procreatio motio est quae ad nouam substantiam perducit. Dum autem quaeuis substantia in alteram commigrat, vt semen in os aut in cartilaginem aut in neruum, ea propriae essentiae commutationem et conuersionem necessariò subit, alioqui enim eadem substantia maneret: simul verò eadem in aptam et conuenientem naturae suae figuram conformatur: hísque duobus absoluitur eius procreatio, substantiae commutatione et conformatione. Ergo quum sit sua cuiusque actionis vis quaedam efficiens, erunt sanè procreatricis facultatis immutatrix et conformatrix (haec quidem vsu mollienda sunt) non vt duae species, sed vtique partes, quibus illa absolutè completur. Vna partis vnius cuiusque substantiam qualem cernimus, ex semine produxit: altera figuram illis compagémque et situm propriis vsibus idoneum contulit. Ergo quot sunt in nobis similarium partium substantiae, totidem planè recensere licet immutatricis illius partis species, quarum suam quaeque substantiam propria quadam commutatione extulit. Alia enim ossis, alia nerui essentiam compleuit, et similiter vnius cuiusque partis substantiam sua quaedam facultas ingenuit, cui liceat à partis natura nomen imponere. Adhūc propemodum multas quibus institui possit conformatricis partis differentias, vt sua cuique instrumento praesit, quae propriam ei figuram atque positionem [P90] asciuit. Omnes hae quidem ad immutatricem et conformatricem referuntur ac pertinent, quae duae vnius procreatricis sunt partes. Huius autem proprium hoc munus esse diximus, partes singulas ipsúmque adeò foetum perficere. Quae in adultis nobis facultas semen conficit, et in foetus constitutionem exhibet, procreatrix dici non meretur, alioqui quae vel sanguinem vel lac vis generat, procreatricis quoque nomen sibi vendicaret: neque qui semen confert propriè

and of heat to enable it to develop its powers, and so without this aid it can accomplish nothing whatever; surely either the body's integrity will be crippled and violated, or the material for accomplishment will be lacking, and then, being absent, will put an end to the work.

Because it cannot attract iron, we refer to a magnet wiped by another one as deprived of its attracting faculty, or at any rate hindered. A person whose gaze is constricted by a cataract is described as blinded, and is deprived of the faculty of sight, or certainly hampered in it. In the same way, someone who is exhausted by old age, with a worn-out, pensioned-off body, does not possess the faculty of growing or of generating new parts; the natural part of the soul in him, if it happens to stay intact, is trapped and entangled by the defects of the body.

We must now discover and explain what parts, and how many parts, form the basis of each natural faculty. Procreation is the motion that leads to new substance. While any substance moves house into another (like seed into bone or cartilage or nerve), it necessarily undergoes a change of its specific essence, for otherwise it would remain the same substance. At the same time it is conformed into a shape appropriate to its nature, and these two steps complete its procreation: change of substance, and conformation. Consequently, since each action has its own efficient power, the faculty of procreation will certainly have powers that produce change and shaping (terms to be mitigated by use), not as two [different] forms, but as parts by which it is brought to completion. One brought out of the seed the substance of each part as we discern it; the other bestowed a shape and structure and location suited to specific functions. Thus the number of substances of similar parts in us can clearly be reckoned the same as the number of forms of that change-creating part; each form has displayed its own substance, by a change peculiar to it. One, for instance, has completed the essence of bone, another that of nerve, and in the same way the substance of each single part has been brought into being by a faculty of its own, which can get its name from the nature of the part. So far, one could set up virtually a large number of different sorts of the shape-making part, so that each instrument could be governed by one of its own, which has [P90] adopted its particular shape and position.

All these are assigned to the changing and conforming faculties,⁴ which are the two parts of the single procreative faculty. We have said that its specific task is to bring into being individual parts, and the fetus itself too. The faculty that in us adults brings the seed into being for the establishing of a fetus does not deserve the name "procreating," otherwise the power that creates blood or milk would claim that name too. Nor is he who contributes seed properly the

generator est, non enim hic foetus particulas effingit aut profert. Abundanter igitur sic enumeratae videri possunt quaecunque procreatrici parent facultates. Altrix porrò est quae adiectum alimentum in corporis substantiam conuertit eique assimilât. Quum enim corporis nostri substantia assiduo fluore variis ex causis continenter dissipetur, neque tamen praeproperè absumi et consenescere id sinant alimenta, proprium certè altricis facultatis munus est nonnihil substantiae pro dispersa resarcire: quod quidem vel par est ei quod effluxit, vel eo vberius vel parcius. Actio qua id efficitur nutritio est, nempe adiecti alimenti in corporis substantiam conuersio et assimilatio: quae omnino triplex deprehenditur, vna priorem corporis habitum conseruat, altera extenuat, tertia saginat et amplificat. Animans omne quoad vitam degit necesse est quodammodo nutriri, siue firma id, siue aegra sit valetudine: nunquam enim otio perfruitur illa vis altrix, vt quam planè naturalem esse constat. Obiici autem potest corpori nil assimilari, quod non plenè conuersum sit et commutatum: atqui ea commutatio nutritio est: non aliud igitur fuerit nutritio quàm procreatio, in qua ex alimento tanquam ex materie, portio quaedam substantiae corporis progignitur. Verum id quidem dum os aut neruus alitur, aliquid fieri: at nihil prorsus sit quod antè non esset. Prius enim et os erat et neruus, neque ad haec simpliciter facta est mutatio, neque ad substantiam se suis viribus sustentem et solitarium, sed ad eam quae pars fit alterius. Sunt qui non ineptè hoc statuunt discriminis, nutritionem motum esse ad materiam, quae prius existente forma ornetur: procreationem verò motum esse ad formam. Commutationem igitur quae ad substantiam simpliciter et per se fit, procreationem: quae verò fit ad substantiam alteri iam per se consistenti adhaerentem, hanc nutritionem appellemus. Augendi facultas est, quae corpus quoquouersum porrigit atque profert. Ipsa autem illius gestio accretio est, nempe corporis quoquouersum porrectio atque prolatio. Quod corporis esse dico, non de vnaquaque parte accipiendum: non enim si quid in maiorem carnis molem atque tumorem dilatatur, id continuò augescit: sed tota incrementi ratio ad solidas duntaxat animantium partes, maximèque ad ossa pertinet, quae si crescunt, animal pariter vniuersum crescit, quanquam idipsum fortasse tum macie extabescit. Quoquouersum autem porriguntur, dum in longitudinis simulque latitudinis et altitudinis dimensiones contendunt atque diffunduntur, quod solius naturae est opus: nulla enim ars potest corpus, quantumlibet tenerum atque sequax,

producer, for it is not he who shapes or brings forth the parts of the fetus. So in this way the faculties that obey the procreating one can be seen to be fully enumerated.

Next, the nourishing faculty is the one that converts and adapts added nutriment into bodily substance. Since the substance of our body is always being dispersed by persistent flux due to various causes, but the nutriments do not let it be consumed and waste away too fast, surely the specific task of the nourishing faculty is to make good the loss with some substance, either a match for what has flowed away, or scantier or more copious. The action that brings this about is nutrition, meaning the alteration and adaptation of added nutriment into body substance. It turns out to be triple, all told: one component maintains the body's previous state, one reduces its bulk, the third fattens and enlarges. So long as its life lasts, every animal must somehow get nourished, whether in sound health or not; that nourishing power never rests, being accepted as entirely natural.

It is possible to object that nothing is adapted to the body without being completely converted; the conversion is nutrition; and so nutrition will be the same as procreation, in which a part of body substance is brought into being from nutriment as the material. While bone or nerve is nourished, it is true that this [nutriment, presumably] becomes something, yet there would be nothing whatever that was not there before. The bone or the nerve was there before, and the conversion is not made simply into them, nor into independent substance supporting itself by its own powers, but into one which is a part of the other [i.e., presumably the one previously there]. Some people make this quite appropriate distinction, that nutrition is movement toward material provided with an already existing form, but procreation is movement toward a form; so let us call conversion going on simply toward a substance and of itself, procreation, but conversion toward substance attaching to another independent substance, nutrition.

The faculty of growth is what extends the body in every direction. Its performance is expansion, meaning the extension of the body in every direction. By "of the body," I do not mean, "of every single part"; for if something expands into a larger swollen mass of flesh, it does not necessarily grow; the whole basis for growth relates just to the solid parts of animals, especially bones. If they grow, the whole animal grows with them, even if it happens to be wasting away at the time. They get stretched out in every direction, by extending and expanding in dimensions of length and at the same time of width and height, and this is the work of nature alone; however soft and pliant a body is, no

integra continuatione in omnem partem dilatare, sed si in longitudinem protrahetur, necessariò fiet aut latitudo aut altitudo contractior. Augetur autem propriè quod ortum iam est, et integram formae suae absolutionem obtinet. Si enim ad hanc etiam nunc progressio sit (veluti quum domus exaedificatur) non vtique accretio, sed constitutio quaedam est. Si pristina species excedit (ceu dum aqueus humor raritate diffusus vertitur in aëra) occasus quidem est et interitus non accretio. Imo neque si aqua sic raritate funditur vt suam insuper speciem retineat, augeri tum putetur, sed rarescere: quia veterem suam soliditatem non retinet. Quod igitur accrescit, integra id iam specie absolutum est, neque illam incremento mutat, et pristina continuatione soliditatèque corporis seruata quoquouersum porrigitur et extenditur. Ex his palàm fit quantum ab ortu vel interitu distet accretio: in illis ad nouam substantiam, hìc ad amplitudinem et molem fit progressus: gignitur quod nondum est neque speciem obtinuit, augetur quod forma perfectum consistit. Si quod augetur pristinam soliditatem debet asseruare, necessum est hanc nutritione alimentique appulsu confirmari, vt quod auctum est in ampliorem molem fusum, inde sibi robor firmitatèque conciliet. Sic igitur accretioni affinis est et coniuncta nutritio, vt nequeat citra eius opem compleri. [P91] Existimari hoc loco fortasse possit, aetate adolescendi dum sequax est corpus, pleniorẽ vberiorẽque nutritionem, esse eam accretionem quam proponimus: quod ipsum sequutus Auiicennas censuit incrementum fieri non posse nisi vberior alimenti fiat accessio, quàm propriae substantiae decessio. At verò plerunque cernimus, tum pueros, tum adolescentes febribus diuturnisque morbis oppressos, grandi macie torreri atque attenuari, qui tamen interea incrementum capessant. Hi quum parcius alantur, planè declarant accretionem neque pleniorẽ nutritionem esse, neque illi perpetuò tanquam comitem assidere. Quinetiam quòd sit unicuiusque viuẽtis corporis certus et constitutus incrementi modus, ad quem non nisi pedetentim statisque temporum spatiis peruenitur: quòd etiam plerique eo sint statu, vt licet vberimè se saginent atque pinguescant, nunquam tamen liberalem illam proceritatem attingant: palàm detegit altricem facultatem ab ea quae in augendo est, non modò appellatione, sed et functionibus et editis operibus plurimùm dissidere. Augendi facultas non quemadmodum altera circa alimentum negotiatur, sed circa corporis partes solidas: has enim quoad sinunt, in omnem partem efferre atque dilatare, proprium illius est munus. His auctis tum deinde altrix facultas adnititur alimentum apponere, affigere et assimilare, non modò quantum effluxit, sed

technique can enlarge it in every direction unbroken; if it is lengthened, either its width or its height must diminish. What increases in size particularly is what is already in being and is securing the complete implementation of its form. If there is to be a gradual development now too toward this, as when a house is being built, it is certainly not an expansion, but an arrangement [“constitutio”]. If the original form departs, as when watery moisture is rarefied and changes into air, this is extinction, not expansion. Further, if water is poured broadcast in such a way as to keep its form as well, it will not be regarded as being increased, but as thinning out, because it loses its previous solidity. So what grows reaches completion with its form intact; it does not change it with an addition, and it extends in every direction with its original continuity and solidity retained. This makes it evident how far expansion differs from coming into being or extinction. The advance in coming into being or extinction is towards new substance, but in expansion it is towards size and bulk. What comes into being is what does not yet exist and has not acquired a form: what increases is what exists perfected in its form. If what increases has to preserve its original solidity, the solidity must be reinforced by the impact of nutrition, to contribute strength to what has grown into larger bulk. Expansion is so closely linked to nutrition that it cannot be completed without its aid.⁵

[Pg1] It might be supposed at this point that in adolescence with a pliable body the more copious nourishing is the expansion we have in mind. Taking this view, Avicenna thought that no increase was possible unless an access of nutriment took place more abundant than the decrease of specific substance. But as a rule what we see are boys and also adolescents in the grip of fevers and prolonged diseases being burnt up and thinned out by great wasting, yet seizing growth in the meantime. Since they are rather sparingly nourished, they make it evident that the expansion is neither more adequate nourishing, nor an invariable accompaniment of it. Further, each living body has a definite established mode of growth, which it attains only gradually and over fixed periods of time. Also, most people are in such a condition that despite fattening themselves very copiously, they never reach the well-known noble height. This reveals that the nourishing faculty differs very greatly from the one involved in growth, not just in name but also in functions and activities. The growth faculty does not occupy itself with nutriment like the other one, but with the solid parts of the body; its specific task is to expand them in every direction so far as they permit. When they have grown, the nourishing faculty follows on by striving to attach and adapt nutriment, not just the amount that has flowed out, but in a

et largiùs ac fusiùs, quò laxiores factas capacitates affatim impleat, conseruétque pristinam earum soliditatem atque robur.

Quatuor facultatum subsidio altricem indigere. Cap. IIII.

FACULTATUM NATURALIUM numerus vt impleatur, ad altricem reuersione facta, quae illi tanquam auxiliae vel administrae parent, huc referendae videntur. Sunt autem hae attrahens, expellens, continens, et concoquens, quarum necessitate corpus alitur et sustinetur. Nulla enim est ne minima quidem corporis particula, quam nonimenti benignitas attingat. Id autem non eò appellit per se impetúque suo motum, quemadmodum nos ex instituto quodam et arbitrio in forum concedimus: sic enim nunquam in superas, sed omne in inferas partes quae sub iecore sunt, grauitatis pondere fluminis instar illaberetur. Quare necesse est aut alieno externóque pulsu agitatam illuc protrudatur, aut allectum trahatur. Atqui ex ventriculo aut iocinere, si per venas in omne corpus pulsum excurrat, vtile pariter ac inutile permixtè illuc confluet, neque quod familiare est et amicum, parti cuique suum conferetur. Restat igitur vt sit sua cuiusque particulae vis attrahendi, quae quod illi familiare est et conueniens, ex sanguinis mole priuata benignitate prolectet. Quum enim partium corporis perampla sit varietas, ob quam non omnes vnus et eiusdemimenti suauitate pascuntur, neque eisdem delitiis capiuntur, erit cuiusque partis quaedam vis et facultas, quae quod sibi aptum erit et iucundum veluti sugat et alliciat. Sic stirpes è terra amoenum succum, sic lapis heraclius ferrum, sic et purgantia medicamenta vnumquempiam è corpore humorem, naturarum substantiarúmque similitudine trahunt. Ea si est facultatis attrahentis necessitas vnicique parti ingenua, necesse est simul et expultricem quandam inesse, quae quod inutile est et superuacaneum depellat. Vt enim conuenientis amicitia atque desiderio res vnaquaeque trahit, ita par est eandem odio et offensione concitatam, quicquid sibi noxium est et infensum extrudere, aut certè respuere. Trahit porrò vt quod familiare est sibi adnectat, eiúsque suauitate perfruatur, et sibi tandem prorsus assimilet: quod dum efficit, id necessariò continet et conseruat (alioqui enim nequaquam eo frueretur) dum autem diutius continet idipsum proprio calore mitigat, immutat atque concoquit. Quare praeter attrahentem et expellentem necessaria quoque intelligi potest continens atque concoquens facultas. Est et altera demonstrationis horum necessitas. Vnumquodqueimenti genus, seu panis, seu caro, seu fructus quiuis aut vinum sit, si animo et cogitatione complexamur, plurimùm

more widespread fashion, to fill full the spaces that have become wider, and preserve their previous solidity and strength.

Chapter 4. The nourishing [faculty] requires the help of four faculties.

TO MAKE up the number of natural faculties by returning to the nourishing one, an account seems required here of those that are subject to it, as aides and handmaidens. They are the attracting, the expelling, the retaining, and the concocting, which the body needs for nourishment and maintenance; there is no tiny part of the body, however small, that is not reached by the bounty of nutriment. It [the bounty] does not bring it [the nutriment] there on its own initiative, in the way that we decide to go to market; if it did, the nutriment would all gravitate like a river to the lower parts below the liver, and never to the upper parts. Hence it must be propelled there by external impact, or drawn there by attraction. But if it is to be pushed from the stomach or liver through the veins to run out into the whole body, the useful and the useless will flow there indiscriminately, and each part will not receive its own congenial contribution. So the remaining possibility is that each small part has its own power to pull in, which entices what is congenial to it out of the bulk of blood, by a limited bounty. As there is a very wide diversity of parts of the body, which prevents them all enjoying consuming one and the same food, or being tempted by the same charms, each part will have a sort of power and faculty to suck in and attract, so to speak, what suits and pleases it. This is the way that plants attract agreeable juice from the earth, a magnet attracts iron, purges draw any particular humor out of the body, through the resemblance of natures and substances. If this requirement for a faculty that pulls in is inborn in each part, there must be an expulsive one there too, to eject what is useless and superfluous. Each thing that pulls in does it by affinity and desire for what suits; correspondingly it is roused by resentment to expel anything harmful to it, or certainly to reject it. Further, it pulls in so as to attach to itself what is congenial and enjoy its charm, and end by assimilating it to itself. While doing this, it must keep its hold on it, for otherwise it would not profit from it at all, and while holding it longer, it softens it by its own heat, transforms and digests it.

Consequently it can be seen that a retaining and digesting faculty is needed also, besides the pulling in and expelling ones. And there is a further compelling feature in the proof of these points. Each single kind of food (bread, or flesh, or any fruit, or wine), if we contemplate it, will be seen to differ a great deal from

à corporis nostri natura distare videbitur, neque posse in nostram substantiam conuerti, planèque assimilari nobis, nisi multifariam varièque mutatum. Neque verò id vniuersum concoctione mutari potest: nam quantumcunque beni-[P92] gnum et familiare sit, alteram partem idoneam ad corpus alendum, alteram discrepantem habet et ineptam. Hanc quidem conuenit è corpore eiici, ne succorum salubrium commodis officiat: quare vis quaedam et facultas in nobis admodum necessaria est, quae pernitiem tantam exturbet. Alimenti quicquid vtile relinquitur, et ad corpus nutriendum conueniens, nisi in partes corporis singulas accedat, eas alere non potest: atqui ad eas non adit suoapte impetu: necesse est igitur alliciatur, et attrahatur. Tractum autem adiectumque nisi aliquantum retentum quasi adhaerescat, concoqui non potest: non enim quod assiduò huc illúcque rapitur, concoctionem facilè subit, vt quae non sic momento temporis compleri potest. Quapropter quandam in nobis necesse est vim inesse, quae alimentum contineat: in summa verò quatuor facultates naturales suas cuique parti insidere, quae nutrici auxiliae sint et ministrae. Nunquid quaeso aliquaepiam his insuper addendae sunt et afferendae? Alimentum quum iam in partem influxit, primùm quidem ei apponitur, deinde agglutinatur et adhaerescit, tum demum perfectè assimilatur, neque vlla nutritionis integritas potest existere, quam non praeueniat agglutinatio, et ante hanc appositio, variae quidem functiones ex propriis effectis conspicuae. Caeterum hae non ex aliis, sed ex narratis duntaxat facultatibus processerunt. Etenim appositio attractionis est finis, et idcirco vnaquaeque pars alimentum trahit, vt sibi iungat et apponat: agglutinatio verò tum retentionem, tum concoctionem consequitur, éstque necessarium vt dum alimentum concoctione concrecit fitque crassius, retentum id parti simul affigatur. Ipsa porrò assimilatio naturalium functionum suprema et tanquam finis, concoquendi facultate perficitur: haec autem facultas summa quum sit in quam reliquae contendunt, vna prae caeteris iure debuit altrix facultas appellari. Huic aliae subministrant omnisque nutritio quatuor duntaxat naturalium facultatum ope completur.

Praeter eas quatuor, non aliam quandam esse naturalem appetendi facultatem, aliam internoscendi, aliam discernendi. Cap. V.²

NON LEUI quidem disputatione philosophi medicique certant, síne in stirpibus appetendi facultas quae illas ad trahendum impellat. Omnes quidem mirificè congruunt naturalem quendam appetitum rebus inesse: atque vt animantia non nisi appetitu animali incitata progredi et incedere, sic neque stirpes, neque corporis nostri particulas quicquam allicere aut depellere, nisi illius naturali appetitu odióve stimulas.

the nature of our body, and cannot be turned into our substance and really be assimilated to us unless changed in numerous diverse ways. Nor can all of it be changed by concoction, for however [P92] kind and congenial it is, it has one part suited to nourish the body and another unsuited and inconsistent. It is appropriate to expel the latter from the body, to prevent it impeding the interests of the healthy juices, and consequently a power and faculty to banish such a great bane is absolutely essential in us. All the useful part of the food that is left, suitable for nourishing the body, cannot nourish the individual parts of the body unless it reaches them, but cannot reach them through its own effort. So it must be enticed and pulled in. Though pulled in and in contact, it cannot be concocted unless it is kept attached for some time. What is incessantly dragged to and fro is slow to undergo concoction, which is not a process thus completed in a moment. Hence there has to be a power in us that can hold on to nutriment. In short: in each part reside its own four natural faculties, which are aides and handmaidens to the nourishing one.

Are there then any others to be introduced over and above these? When nutriment has run into a part, it is first in contact with it, then fastened and attached to it, then ends up completely assimilated. There can be no sound nutrition unless it is preceded by attachment, and before that being in contact, diverse functions evident by their specific effects. But these functions have not emerged from other faculties, only from those described. Contact is the aim of the pulling in, and each part pulls in nutriment so as to get in contact with it. Attachment follows upon both retention and concoction, and is necessary so that during the coagulation and thickening of the food by concoction it stays attached to the part. Next, assimilation, the last of the natural functions and their fulfillment, is achieved by the faculty of concoction. Since this faculty is the last and the one the others are making for, it alone rather than the rest should rightly be called the nourishing faculty. The others aid it, and the whole of nutrition is completed by the help of just the four natural faculties.

Chapter 5. Over and above these four, there is no other natural faculty of appetite, neither of distinguishing, nor of separating.

PHILOSOPHERS AND physicians argue very seriously whether plants possess a faculty of appetite that constrains them to pull things in. There is remarkable universal agreement that a natural appetite exists in things; as animals do not step forward without the stimulus of animal appetite, so the parts of our body do not pull or reject anything unless urged by a natural appetite or distaste for it.

Quod enim familiare sibi iucundumque est, idcirco trahunt et alliciunt, quia illius desiderio tenentur: quod verò nociturum et aduersum est, id quia despuunt et aspernantur, expellunt. Caeterum in hoc tota controuersia est, num vt in animalibus, ita in stirpibus, et in his quae sola duce natura reguntur, propria quaedam instituenda sit appetendi facultas. Hanc equidem minime necessariam duco, sed quaecunque attrahit, eadem quod familiare est atque salutare appetit: hoc autem iucundum est et amicum quia simile: similitudo quippe amicitiam, amicitia desiderium seu appetitum, appetitus attractionem mouet. Sic propemodum et quaecunque expellendi facultas est, eadem quod noxium et pestiferum est auersatur et respuit, quia inimicum atque dissimile. Hinc autem alia difficilior quaestio existit, stirpésne ea sensu quodam, vt nos, percipiant et internoscant quae sibi salutaria pestiferáue sunt. Non pauci illas quemadmodum et corporis nostri particulas naturali quadam cognitione duci arbitrantur, íisque vim tribuunt internoscendi salutaria à pestiferis. Hanc discernentem et quae suauia insuauíaque distinguit facultatem, sensum quendam appellant, non vtique ceu aspectum, auditum, odoratum, gustatum, aut tactum: sed proprium quendam et naturalem sensum, qui quae nutrire possint et quae secus, duntaxat diiudicet. Itaque non modò ventriculum, iecur, partésque singulas, verumetiam frutices existimant suauium et idoneorum sensu atque voluptate affici, haecque si desint protinus appetere, quia verò appetant eadem attrahere, vt tandem optatis fruantur et voluptatis fructum percipiant. Haec Platonis consulta esse perhibent, quem constat stirpes nonnunquam animantes appellasse. At verò Aristoteles his aduersatur, qui satis [P93] omnibus atque plantis vim illam insidentem salutarium et idoneorum attractricem, censet appetitu solo naturali impelli, citra vllam vtilium cognitionem. Neque vllam stirpibus vim inesse posse, quae idoneum ab alieno discernat et internoscat, sed hoc altioris duntaxat illius esse facultatis quam communem sensum appellant. Appetitus autem is, vt caeteris quibusque rebus est suus, grauibz vt deorsum ruant, leuibz vt in sublime conuolent: sic propemodum magneti purgantibúsque medicamentis appetitus est ingenitus attrahendi quod sibi affine est et amicum, stirpibus conuenientem succum è terra sugendi. Hunc verò appetitum incitat et impellit non sensus aut cognitio, sed penuria et indigentia eius quod familiare est et iucundum. Ergo substantiarum conuenientia atque similitudo amicitiam parit, quúmque similis atque iucundi erit indigentia, haec appetitum suscitabit naturalem, appetitus attractionem, eóque fruetur attrahendi facultas, si quidem praesens id est, nec aliunde impedimentum obtingit. Nulla

They pull and entice what is congenial and pleasant to them because they are possessed by a desire for it; what is going to harm them they eject because they spurn it. But the whole point of argument here is whether in animals, in plants, and in things controlled just by nature's guidance alike, a particular faculty of appetite is to be established. For myself, I regard it as barely necessary, but whatever pulls in, desires what is congenial and healthy; this is pleasant and in accord because it bears a resemblance. Resemblance evokes concord, concord longing or appetite, and appetite the inclination to pull in. In the same way the faculty of ejecting is revolted by what is harmful, because it is discordant and different. From this another harder question arises: do plants distinguish what is healthy or harmful for them by some sense, as we do? Quite a number of people believe that they resemble the parts of our body in being guided by some natural comprehension, and bestow on them the power to distinguish the healthy from the harmful. This discriminating faculty that distinguishes pleasant from unpleasant they call a kind of sense, not quite like sight, hearing, smell, taste, or touch, but a specific and natural sense that just distinguishes what is nutritious from what is not. And so they believe that not only the stomach, liver, and individual parts, but even bushes are provided with a sense and appreciation of pleasant and appropriate things; if these are lacking, they at once want them; because they want them they attract them, so as to achieve their desire and perceive the benefit of their appreciation. These people regard these views as Plato's, since it is accepted that he sometimes called plants animals.⁶ But Aristotle differs, holding that the power resident in all [P93] crops and plants that attracts healthy and suitable things is driven by natural appetite alone, without any recognition of useful things. And he held that no power could exist in plants to distinguish the suitable from the unsuitable, but this was the work only of that more elevated faculty that they call the general sense. Appetite, however, is what all the other things have as theirs, to make heavy things plunge down and light things fly upward. In almost the same way the magnet and medicinal purges have an inborn appetite for attracting what is akin and congenial to them, and plants have one for sucking appropriate juice out of the earth. But what provokes this appetite is not the senses or knowledge, but dearth of what is welcome and enjoyable. Therefore harmony and resemblance of substances prompts accord, and when there is dearth of what is similar and pleasant, it will evoke natural appetite, appetite will evoke attraction ["attraction"], and the faculty of attraction will avail itself of what is similar and pleasant, so long as it is at hand and no obstacle appears from elsewhere. So there is no

igitur necessitate introducenda est discernendi et internoscendi facultas, cuius consilio atque prudentia stirpes corporisque nostri particulae regi viderentur.

Non aliter quae de secernente et separante facultate controuersia est, dirimitur. Quòd enim renes serum à reliquo sanguine secernant, quòdque natura in morbis post concoctiones, humores secernat et superuacuos exigit, quo tempore fiunt iudicationes: quòd denique oporteat concoctionem praeire, subsequi verò secretionem, et postea euacuationem, vt bona sit crisis, omnes quidem fatemur. At verò ea ipsa secretio non propriae cuiusdam est facultatis, sed aut excernentis aut attrahentis opus. Quae enim facultas post factam in morbis concoctionem confusos in venis maioribus humores puros ab impuris secernit, eadem est expultrix, quae nihil depellere potest, quod non antè à reliquis quasi euulserit. Quae verò superuacuos humores è iecoris sanguine secernit, ea est attrahendi vis, quae tum in liene, tum in bilis folliculo consistit: et quae serum separat à sanguine, eadem est vis attrahendi renum. Sic et è sanguinis mole quae in venis est maioribus, partes singulae quod sibi familiare est, eadem facultate secernunt qua attrahunt. Quocirca secretio non propriae cuiusdam facultatis est opus, sed vel expulsionis vel attractionis initium.

Aliis partibus alias facultates naturales esse valentiores, iisque propria quaedam functionum instrumenta destinata esse et attributa. Cap. VI.

PARTES CORPORIS tanta consensione inter se coniunctae sunt, vt omnes communiter totius commodis vtilitatique inseruiant, omniùmque vsus in id vno quasi concentu conspirent. Harum actiones quae naturales appellantur, duplices existunt: aliae propriae vni cuiuspiam addictae parti, vt ossi vt cartilagini, et reliquis quoque omnibus: nulla enim pars est in nobis vel minima, quae non seipsam alat atque conseruet: aliae communes omnium partium gratia comparatae, quales sunt quae in ventriculo et iecore praeter proprias consistunt, ad totius partiùmque omnium vtilitatem et commodum natae. Sic oesophago manifesta vis est alimentum trahendi, sic ventriculo vt et iecori praeter proprias, communes illae omnes insident, inter quas tamen vis illa ad concoquendum valens excellit. Sic in intestinis expultrix validissima, concoctrix infirma inest, reliquae duae deficiunt. Renibus eliciendae è venis vrinae facultas praestantissima, eique profundendae et deiiciendae non imbecilla: reliquarum autem ij sunt expertes. Sic denique vtero vis continendi robustissima,

compulsion to introduce a faculty of distinguishing, whose wise advice would be considered to control plants and the parts of our body.

The argument about the separating faculty is settled in the same way. We all agree that the kidneys separate serum from the rest of the blood, and that in diseases nature separates humors after concoctions and expels the superfluous ones, at the time when crises occur. Finally, we all agree that concoction ought to come first, separation should follow, and then evacuation, to give a good crisis. But this same separation is not the work of some special faculty, but of the faculty that excretes or attracts. The faculty that, after a concoction in disease, separates the pure mixed humors in the great veins from the impure is the expulsive faculty, which cannot remove anything without previously (so to speak) tearing it out from the rest. What separates the superfluous humors from the hepatic blood is the power of attraction, which is present in both the spleen and the gallbladder; and the one that separates serum from blood is the renal power of attraction. In this way too, individual parts separate what is congenial to them out of the bulk of blood in the great veins, by the same faculty by which they attract. Consequently the separation is not the work of some special faculty, but the commencement of expulsion or of attraction.

Chapter 6. Different natural faculties are more effective for different parts, and have assigned to them particular instruments for functioning.

THE PARTS of the body are linked together in such harmony that they all minister together to the interests of the whole, an aim to which the purposes of all of them contribute in, so to speak, a single concord. What are called their natural actions prove to be of two kinds: some assigned to any one particular part, like bone, cartilage, and all the rest; there is no part in us too small to nourish and maintain itself. Others are provided in common for the benefit of all parts, like those that reside in the stomach and liver in addition to their particular ones, and are in being for the good of the whole and all its parts. Thus the esophagus has in it an obvious power of attracting food; thus the stomach and liver have in them (besides their particular powers) the well-known general powers, among which the concocting power is outstandingly potent. Thus there is a very strong expulsive power in the intestines, but a weak concocting power; the other two are absent. The kidneys have a really outstanding faculty of enticing urine out of the veins, and quite a strong one of pouring it out and ejecting it; they lack the others. Lastly, the uterus similarly has a very strong

qui foetum nouem integris mensibus reconditum gerat; nec parum huic validae allectandi seminis et foetus exigendi vires, at concoquendi prorsus nullae. Itaque partes illae vt et aliae nonnullae, quae non modò priuato, sed publico quoque munere funguntur ac vigent, instrumentorum speciem acceperunt, et iis muneribus ad quae in primis sunt propensae staminum villorúmque proprium genus adeptae sunt. Triplex autem est hoc illorum genus, alia enim recta sunt in longitudinem porrecta, alia transuersa quae ad pares rectósque angulos in illa feruntur et incidunt, obliqua alia quae obliquè et ad impares angulos in recta incidunt. Quanquam igitur concoquendi vis nullum staminum genus, sed humidum duntaxat calorem nobis ingenitum ad concoctionem accommodat, reliquae tamen quae motu [P94] quopiam munus suum explent, villis indiguerunt: attrahens quidem rectis, transuersis expultrix, continens obliquis. Vt enim in musculis villi nutu nostro et arbitrio contracti, et ad suam originem quasi reducti motum efficiunt: ita et naturalibus instrumentis, recti villi solius naturae instinctu contracti breuiorésque facti alimentum attrahunt: transuersi autem astricti, subditam capacitatem in angustiam adducunt, et quicquid ea concipitur detrudunt: caeterum obliqui villi quia intenti, nec breuiorem nec angustiore partem reddunt, seruata quadam naturali aequabilitate et constantia, omnia planè continent, nihílque vel attrahunt vel expellunt. Cuicunque igitur naturae instrumento triplex huiusmodi facultas accessit, triplex etiam villorum genus est concessum, aliàs tunica simplici vt in vtero, aliàs vt in ventriculo duplici. Quibus verò istarum virium vnica data est vt intestinis, iis (tametsi geminae sunt tunicae) simplex villorum genus obtigit. Quapropter facultatum parti unicuique assidentium numerus ex functionum varietate cognitus, villorum differentias explicat: econtrariò quoque villorum varietas consecutione cognita renuntiat quot cuiusque partis sunt facultates, gulae, ventriculi, intestinorum, arteriarum, venarum, vteri, vtriusque vesicae, et aliorum si plura his publica naturae sunt instrumenta. At verò quae sibi duntaxat priuatísque commodis dant operam, vt ossa, vt cartilagines, etsi quò se alant naturalium facultatum species omnes assequutae sunt, nullius tamen villi opere indigent, sed ingenita vi omnia efficiunt et edunt. Neque porrò ventriculus neque intestina vt se duntaxat alant et conseruent, suos villos ad proprij alimenti attractionem et retentionem, aut ad superuacaneorum depulsionem applicant et accommodant. His

retentive power, to carry the fetus in concealment for nine whole months, and it has adequately potent powers of enticing seed and ejecting a fetus, but no powers of concoction at all. Consequently these parts, like a number of others, which successfully perform not only a private but also a public task, have acquired the form of instruments, and gained a kind of threads and filaments appropriate for the tasks to which they are primarily disposed. This kind of threads and filaments is triple: some run straight lengthwise; some run transverse to form equal and right angles with the straight ones; and some are oblique and cut across the straight ones obliquely at unequal angles. So although the power of concoction does not apply any kind of threads to concoction, but simply the moist heat in being within us, yet the rest of the powers, discharging their [P94] task by some movement, have needed filaments: the power that attracts has needed straight filaments, the expulsive power transverse ones, the retaining power oblique ones.

In muscles there are filaments that make a movement by being contracted at our command, and pulled back to their origin. In the same way natural instruments have straight filaments that contract and shorten through natural instinct alone and draw in food; and when the transverse ones tighten, they narrow the space within, and push down anything held there. But because the oblique ones when put on the stretch make the part neither shorter nor narrower, by maintaining the natural steady state they hold everything quite in, neither attracting nor ejecting anything. Every instrument of nature therefore that has acquired a triple faculty of this sort is endowed with a triple kind of filaments too, sometimes in a simple coat as in the womb, and sometimes in a double one as in the stomach. Instruments such as the intestines that have been given a single one of these powers are found with a simple kind of filaments, even if they have twin coats. It follows that the number of faculties residing in each part can be discovered from the variety of its functions, and accounts for the different sorts of its filaments. And conversely, the variety of filaments determined by dissection declares the number of faculties of any part: esophagus, stomach, intestines, arteries, veins, womb, both bladders [gall and urinary], and any general instruments of nature there may be in addition to these.

But parts like bones and cartilages that devote their effort just to themselves and their private interests, even if they have achieved all the forms of natural faculties so as to nourish themselves, still need the activity of no filament, but bring everything about by inherent power. Further, stomach and intestines do not apply their filaments to attracting and retaining their own nutriment or to the expulsion of refuse, so as just to nourish and maintain themselves. With this

iam videor vniuersam principum naturae facultatum summam attigisse, necnon reliquarum omnium quarum illae opera et ministerio vtuntur, numerum percensuisse: quocircà tempestiuum erit ad animalium facultatum differentias sermonem transferre.

Externae sentiendi facultates. Cap. VII.

FACULTATUM ANIMALIUM quae non vtique stirpibus, sed solis animantibus obtigerunt, vnde et illis nomen accessit, duo prima summâque genera existunt: aliae rationis sunt participes, huius expertes aliae, quae sensus duntaxat impetu feruntur. Quae brutis animantibus supra naturalem illam vim, moderatur praecipuâque administrationem tenet sentiens anima, tota quidem essentia simplex est, sui tota persimilis, neque vt corpus ex partibus coagmentata disparibus: aliàs vnum eiusdémque generis nequaquam id esset quod ex ea constaret. Huius tamen vnus effectione et opera animal cernit, odoratur, audit, gustat, tangit atque tractat: quinetiam mouetur, rerum discrimina internoscit, cogitatione fingit, somniat, meminit. Haec vnus et eiusdem sunt essentiae munera, non tamen ea dum exequitur et perficit, vno similique modo se semper exhibet, sed vt varia corporis instrumenta ad effectiorem accommodat, ita aliàs aliter sese exprimens illa profert. Vnde quum sic discretæ sint horum munerum gestiones, vt possint singulae seorsum atque separatim consistere, neque vna quapiam concita sit necesse alias continuò proferri, aut vna pereunte reliquas omnes pariter occumbere; optima fit ratione vt sua sit cuiusque propria quaedam facultas, sintque totidem sentiendi facultates, quot functionum differentias numerando percensuimus. Vniuersum igitur animalium facultatum genus ita partiemur, vt aliae rationis, aliae sensus sint effectrices: harum autem quae brutis animantibus imperant, aliae externa sentiunt, aliae loco mouent, aliae cognoscunt. Quae demum externa sentiunt quinque statuuntur, cernendi, odorandi, audiendi, gustandi, atque tractandi. Qua videt animal, ea ipsa facultate nec audit, nec odoratur, nec gustat, nec tangit, vti neque ex aduerso fieri quicquam potest: tanta scilicet est inter eas distantia, quam et instrumentorum et obiectorum in quae incumbunt varietas peperit. Quocunque sentimus, id quemadmodum caeterorum corporum vnumquodque, ex subjecta materia et specie constituitur: sentiendi instrumentum tanquam materia est, sensus tanquam forma et ratio. Aspectus qui facultas est videndi, tanquam forma in crystallino oculi [P95] humore consedit, qui pellucidus primum est cernendi organum: circumfusus id humoribus, tunicisque septum, quae vsum

I feel I have entirely covered the principal natural faculties, and also surveyed the number of all the rest, of which they use the activity and assistance. Thus it will be the moment to shift discussion to the distinctions of the animal faculties.

Chapter 7. The faculties of external sensation.

THERE ARE two key and cardinal kinds of animal faculties that only animals come by (hence the name “animal faculties”), and certainly not plants. One kind has a share of reason, which the other kind lacks, being driven just by the impulse of the senses. The sentient soul, which guides brute animals in addition to the natural force and is in particular control [of them], is simple in its whole essence, entirely uniform, and not assembled from disparate parts like the body; otherwise what consisted of it would not be a unity and of the same kind. Through the effective operation of it alone the animal sees, smells, hears, tastes, touches, and handles; what is more, it moves, discriminates things, imagines, dreams, remembers. Though these are functions of one and the same essence, while performing them its conduct is not always identical; as it brings various bodily instruments into effect, it displays them in different ways at different times when expressing itself.⁷ The performances of these functions are so separate that they can each exist entirely apart, and when any one has been called into action it does not have to be prolonged continuously elsewhere, nor does the end of one mean the demise of all together. Hence it is an excellent argument that each has its own particular faculty, and that there are just as many faculties of sensation as we reckoned there were different functions. We shall therefore split up the whole kind of animal faculties in such a way that some bring about reasoning and others sensation. Of those that control brute animals, some sense the outside world, some move them along, some get knowledge. There are five that only sense the outside world, those of seeing, smelling, hearing, tasting, and handling. The faculty by which the animal sees is not the one by which it hears, smells, tastes or touches, nor can anything happen vice versa. There is in fact as great a discrepancy between them as has been produced by the variety of instruments and objects on which they impinge. Everything by which we sense is, like each of the other bodies, the product of the subject material and the form; the instrument of sensation is what we might call the material, the sensation is what we might call the form and basis. The gaze, which is the visual faculty, has lodged as a form does in the crystalline [P95] humor of the eye, which is very transparent and is the primary organ of sight. It is surrounded with humors, and enclosed in coats that contribute usefulness to

ei conferunt, vt melior completiôrque fit visio. Cernit quidem simpliciter oculus crystallino, integrè verò ac perfectè visus instrumento: sub hunc autem sensum veniunt ij maximè colores qui corporibus per summa insident. Eos enim hic vnus prae caeteris internoscit discernítque singulos, caeterorum autem nullus. Quocircà cernendi facultatem eam esse definimus, quae in oculo sita colores citra materiem, per medium re ipsa conspicuum excipit. Quum autem vnusquisque sensus à prima anima quasi praecisus abiunctúsque videatur, et sua cuique spiritus portio illinc ad functionem et ministerium tributa sit, poterit reliquis ad visus exemplum finitio accommodari propria. Praecipuum audiendi instrumentum est aër quidam praetenuis auribus ingenitus, membrana obductus, ad aurium intimam capacitatem positus, quò audientis nerui à cerebro ducti extremum pertingit. Hic enim ingenitum eum aërem atque spiritum, qui primum est audiendi instrumentum ambit, quemadmodum opticus in oculo neruus crystallinum humorem: sic in omnibus per influentem spiritum et per neruum maxima instrumento societas intercedit cum intimo sentiendi principio. Huic igitur aëri insidens audiendi facultas sonum verè percipit, eiúsque discrimina diiudicat. Odorandi proprium instrumentum extra caluam non excidit, respirantibus quibusque animantibus opertum et penitus conditum in iis extremis cerebri, quae ad nasi summum pertinent. Vnde intelligitur hos quinque sensus non quòd foras exprompti sint et promineant, sed quòd externarum rerum propriis organis cognitionem capiant, idcirco externos appellari. Illic constituta odorandi facultas per narium ductus, vnà cum spiritu haustos rerum odores comprehendit, qui subiecta eius sunt materia in qua solet versari. In his porro maximè neruis quos ad linguam, ad palatum, ad fauciúmque regionem dispergi narrauimus, gustandi facultas consedit, rerum sapes internoscens, spongiosae eius carnis adminiculo qua lingua praedita est. Caeterùm vis tangendi nullo proprio conclusa organo coërcetur, sed quum tactus ad animantis vitam maxime videtur necessarius, toto corpore aequabiliter fusus est. In his autem neruis potissimum collocatur, qui duriores iam facti intrò forásque comeant: per quos corporum omnium tractabiles qualitates animaduertit. Hae non vt colores, sapes, odores, aut soni, vno possunt nomine designari, multis quidem contrariorum pugnantiis discretæ: quarum extrema sunt calor et frigus, humor et siccitas, mollitudo durities, asperitas laeuitas, grauitas et leuitas. Hinc nonnulli complures tactus instituerunt, qui has seorsum differentias perciperent, quasi

it, so that vision becomes better and more perfect. The eye sees simply [*simpliciter*] by the crystalline humor, which is completely and fully the instrument of vision. Under this sense there come mainly two colors that are present in bodies over their surfaces. It is the only sense that can distinguish each of them apart; no other sense can. So we define the faculty of seeing as the one that dwells in the eye and collects colors but not the material, through a really transparent medium. But since each single sense appears as if severed from the original soul, and its own portion of spirit is allotted from there to a function, it will be possible to fit a specific definition to the rest, on the model of vision. The particular instrument of hearing is a very rarefied air inherent in the ears, enclosed in a membrane and situated at the inmost cavity of the ears, at the point reached by the end of the auditory nerve running out from the brain. The nerve surrounds the inherent air and spirit that is the primary instrument of hearing, in the way that the optic nerve in the eye surrounds the crystalline humor. Similarly in every one of the senses there is the closest interaction between the instrument and the inmost principle of sensation, through the inflowing spirit and the nerve. So the faculty of hearing, being resident in this air, genuinely perceives the sound, and distinguishes its fine points. The special instrument of smell does not extend beyond the braincase; in all animals that breathe it is covered and deeply concealed in the tips of the brain that reach the top of the nose. Hence it follows that these five⁸ senses are called the external senses not because of protruding outside, but because they acquire knowledge of external things by their specific organs.

Established where it is, the faculty of smell gets hold of the odors of things when these odors have been drawn up along with spirit through the nasal passages, and they are its subject material and normal concern. Further, the faculty of taste resides mainly in the nerves that we described as distributed to the tongue, palate, and faucial region. It distinguishes the tastes of things, with the aid of the spongy flesh possessed by the tongue.

But the power of touch is not confined within any organ of its own; as touch appears particularly necessary for an animal's life, it is distributed evenly over the whole body. It is, however, especially associated with nerves that have become harder and run inwards and outwards. By them it discerns the handling qualities of all bodies. Unlike colors, tastes, odors, or sounds, they cannot be covered by a single name, being separated in many antagonistic contraries, whose endpoints are heat and cold, moistness and dryness, softness and hardness, roughness and smoothness, heaviness and lightness. Hence some people have proposed several touches, to perceive these differences apart, as if the

ex obiectarum qualitatum varietate sensuum numerus petatur: non sic autem, sed ex organorum differentia facultatum numerus aestimandus. Atqui vnum est atque simplex tactus instrumentum. Distat praeterea sensus hic à caeteris quòd non omnia subiecta prorsus sentiat, quaecunque enim obiecta sibi temperatione similia offenderit, non sentiet, quia ab illis nihil patitur. Sensus autem non nisi perperione quadam fieri potest. Reliqui verò sensus eas omnes quae sub se recidunt qualitates sentiunt, ab hisque patiuntur: quia dissimiles sunt omnes. Commune autem est omnium sensuum, vt sit vnusquisque potestate talis, quale idipsum est quod percepturus est: hoc enim extrinsecus positum sensum impellit ac mouet: quòd si sensus ab subiecta re afficitur, necesse est tum similitudo tum dissimilitudo quaedam intercedat. Inter motus quidem initia similitudo: quum finis attingitur, dissimilitudo: quod quomodo fiat, plenius suo loco recitabitur. Commune praeterea est, vt vnusquisque tum subiectas sibi res cognoscat, tum earum priuationes, tum verò excessus immoderatos, sed via rationéque diuersa. Quandoquidem propria obiecta et idonea blandè impulsus excipit, priuationes nulla irruptione, nullo inuitamento lacessitus: excessus autem et exuperantias non citra offensionem oblaesionémque sustinere potest: vnde et illas quia graues sint et violentae, multi non sentiri putant. Itaque distant inter se sensus omnes, longéque sunt diuersae atque seiunctae eorum facultates, non modò ex rei quae comprehenditur natura, verumetiam ex proprio cuiusque instrumento. Hoc visui aqueum est et pellucidum: nam oculus multiplici humore perfusus est, à cerebro constitutus atque pro-[P96] fectus, quod omnium partium humidissimum est et frigidissimum. Auditui aëreum est instrumentum, odoratui igneum, quemadmodum et odor exhalatio quaedam est fumosa et ignea: tactui instrumentum datum est planè terrenum, gustandi (quia ceu tactus quidam est) id etiam terrenum, sed humoris quoque alicuius particeps.

Interiores sentientis animae facultates. Cap. VIII.

SENTIENS ANIMA duas cognoscendi facultates obtinet, externam, in sensus quinque tanquam in species distributam, et interiorem. Haec porrò species habet, vim discernendi communem, vim fictricem, et eam quae meminit atque recordatur. Has quidem omnes vnus animae non tanquam partes, sed vtique facultates esse, perspicuum ex iis fit, quae de partium et facultatum discrimine à nobis sunt prodita: quae quemadmodum diuersae sint, et ab eadem essentia dimanent, deinceps aperiendum.

number of faculties ought to be derived from the repertoire of object qualities. But this is not the way to reckon the number of faculties; it should be done from the distinguishing characteristic of the organs.

Yet the instrument of touch is a single uncomplicated one. Further, touch differs from the others in not completely sensing everything set before it, for it will not sense anything it encounters that is like it in temperament, being unaffected by it. A sense cannot exist without something being done to it. The remaining senses perceive and are affected by all the qualities that fall under them, because they are all different.⁹ And it is a feature common to all senses, that each of them is in potentiality of the same kind as the thing it is going to perceive, which from its external position stirs the sense. But if a sense is influenced by its subject, both a likeness and an unlikeness must exist between them. There is a likeness between the origins of a movement, but when its termination is achieved, an unlikeness; how this comes about will be described more fully in its proper place. It is a further general characteristic [of senses] that each comprehends its subject materials, and the absence [or removal] of them, and also excessive deviations, but by a different route and on a different basis. Under gentle stimulation it accepts its own proper objects, and so can endure absences without harassment from any intrusion or any inducement. But it cannot endure overloads¹⁰ without damage. Consequently many people think that these are not sensed, because they are oppressively violent. So all the senses differ from each other, and their faculties diverge widely, not only in the nature of the thing they grasp, but also in the particular instrument each has. For vision it is watery and clear, since the eye is imbued with a complex humor, and is established and [P96] developed by the brain, of all the parts the most moist and cold. Hearing has an airy instrument; smell a fiery one, as an odor is a smoky and fiery vapor. Touch has been given an entirely earthy one, taste (being something like a touch) an earthy one too, but with a share of some moistness.

Chapter 8. Internal faculties of the sentient soul.

THE SENTIENT soul possesses two faculties for acquiring knowledge: an external one, divided into five senses as though into forms ["species"], and an internal one, which has forms too: the general power of discrimination, the power of imagination, and the power of memory and recollection. That all these are not just like parts of a single soul, but are precisely faculties of it, is clear from what we said about the distinction between parts and faculties. The way in which they differ, and diverge from the same essence, will be disclosed

Sentiens ea et cognoscens anima in cerebri quidem corpore tanquam in arce et propria sede penitus insedit, quod inde proprium sentiendi instrumentum appellant. Id etiam primum sensum dixere, quod reliqui sensus externi ei omnes circumiecti proximè assideant, in quos et in omne corpus neruorum propagines dispersae sunt, quibus anima vires suas effundit. Vt enim ab orbis ambitu lineae pares tanquam radij in centrum deurgunt, sic à sensibus viae quaedam et foramina patent, per quae haustae rerum imagines in illud tanquam in arcem confluunt. Harum autem aestimator et arbiter est princeps ille sensus, quem communem et intimum appellant. Nigrum ab albo potest vnus aspectus discernere, et calidum à frigido vna tangendi facultas: quae verò dulce ab albo discernat, atque eorum quae variis subiecta sunt sensibus differentias diiudicet, facultatem quandam esse necesse est istis praestantiorum. Nullus enim externus sensus de dulci et albo potest iudicium ferre, quod ea non vnus idemque sentiat: quemadmodum si ego hoc, tu verò illud separatim perceperis, à neutro certè nostrum diuersa illa cognoscuntur. Quoniam igitur multorum sensuum subiectam materiam, non modò homines, sed beluae quoque internoscunt, necesse est vim quandam esse communem et promiscuam, quae varias illorum imagines complectatur, quae et similia et discrepantia diiudicet. Haec est discernendi et internoscendi interior facultas, quam primam communis ille et intimus sensus expromit. Hic autem substantia est animae sentientis, idque principium quod vniuersum animantium genus constituit, à quo et animantes omnes vel quae infimo sunt insectorum ordine, sentientes appellamus. Hic tanquam rex atque princeps sedem stabilem et domicilium certum habet in cerebri corpore, è quo tanquam è suggesto rerum omnium imagines à ministris et nuntiis sensibus extrinsecus allatas et ante se positas contemplatur, omnesque sensuum actiones obseruat. Hic ille est quo nos visu videre, et auditu audire cognoscimus. Hic imaginum discrimina constituit, ac de illis suum promittit iudicium. Ex quo intelligitur communem hunc et intimum sensum cum externis quinque quodammodo eundem esse, hosque ab illo omnes tanquam à fonte riuulos deriuari: et vim illam primam sentiendi è cerebro in sensuum instrumenta se diffundere, eorumque famulatu vti et opera. Haec autem quia se variè gerunt, et vnus opificis visibus sese multifariam accommodant, idcirco quinque exteriorum sensuum facultates constituere par est, sed quarum sit vna eademque cum sensu principe substantia. Ea est igitur principis sensus vna facultas, quae externarum rerum varietates discernit, internoscit, et iudicat.

next. The sentient and inquiring soul dwells deep in the body of the brain as though in its own stronghold, and this body is therefore called the special instrument of sensation. People also called it the primary sense, because the rest of the external senses lie close around it; nerve branches are distributed into them and into the whole body, branches by which the soul sends forth its powers. In the way that equal lines as radii from the circumference of a circle make for the center, paths and apertures lie open from the senses, along which the images derived from things flow into that "stronghold." They are assessed by that principal sense that is called the common and inmost sense. A single glance can distinguish black from white, and a single faculty of touch distinguish hot from cold. But a faculty surpassing them is required to distinguish sweet from white, and to assess the differences between things that are the subjects of different senses. No external sense can form a judgment about sweetness and whiteness, because they are not perceived by one and the same sense. Similarly, if I have perceived one thing and you separately another, surely neither of us will recognize them as different. Not only people but beasts too discriminate material that is the subject of many senses; so there must be some general widespread power that is to embrace their diverse images and assess similarity and difference. It is the internal faculty of discriminating and comparing; it is the first to be brought into play by the general and inmost sense, which is the substance of the sentient soul, and is the principle that establishes the whole kind of animals, and the principle from which we refer to all animals as sentient, even those of the lowest rank of insects. Like a ruling governor, it occupies a permanent sure place in the body of the brain, which it uses like a platform for surveying the images of everything that are brought in by the help of sensory messengers and placed before it, and for studying every action of the senses. With it we know that we see by sight, and hear by [sense of] hearing. It produces comparisons between images, and delivers judgment upon them. It follows that this general and intimate sense is in a way the same as the five external ones, that they all flow from it like streams from a spring, and that the primary power of sensing distributes itself from the brain into the instruments of the senses and uses their subservient effort. These senses behave diversely and adapt themselves in many ways to the needs of the single craftsman. So it is proper to agree on five faculties of external senses, but they are to have one and the same substance as the principal sense. There is therefore a single faculty of the principal sense, the faculty that distinguishes, compares, and assesses the diversities of external things.

Altera est vis et facultas conservatrix, quae impressiones et vestigia sensuum excipit, continet, et recondit. Quum enim externus sensus in subiectam rem incumbit, simul quoque in eam ipsam fertur interior et princeps illa sentiendi facultas, quae rem vnà percipit atque sentit: ab externis rebus lacessiti sensus simulachra [*sic*] spectráque ab eis emissa recipiunt, quae deinde interiori sentiendi vim impellunt: haec tum formas atque imagines rerum quas sensus praebuerunt, retinet et consignat in se. Digressis sublatísque rebus istae diutius inhaerent, et quasi exculptae conseruantur, hoc indicio quòd tum abstractas res sensus ille cognoscit ac percipit, vt cui earum custodia esset concredita. Effigies illae spectráque rerum ce-[P97] rebro inusta atque insculpta, obiectum efficiuntur facultatis eius quae fingit, quemadmodum res externae sensuum. Hos enim externae, illam interiores qualitates extimulant. Ab illis ergo excitata alia quaedam facultas quae fictrix appellatur, et quae tertia est interiorum, obiecta spectra apprehendit et concipit: atque vt in sensu tria quidem sunt, res obiecta, vis sentiens, et actio quae ex illorum congressu interuenit, ita haec quoque ratio tribus continebitur, simulachro, facultate fingendi, et ipsa actione, qua externis rebus abiunctis facultas ob simulachrum versatur. Haec proprié [*sic; acute accent*] effectio appellatur, nempe motio facultatis circa rerum duntaxat simulachra atque vestigia. Ex iis autem confusis et permistis plerunque multa fingendo inducit atque profert, quae sub sensum non venerant, vt homines volantes, boues alatos, hócque à superiore facultate dissidet. Vnde quum in multa feratur nunquam sensu percepta, et quodammodo vim imitetur rationalem, ab Aristotele intelligentiae larga appellatione comprehenditur. Iam verò rerum simulachra aut leuiter cerebro impressa, mox euanescunt, aut altiùs quasi in thesauros condita, diu tanquam affectiones aut habitus insistent et asseruantur, haecque imaginum conseruatio, cuius antè mentionem feci, memoria est, quae pueris atque senibus infirma et inconstans esse proditur, illis quòd imaginum impressionem seruare atque retinere, his verò quia admittere et recipere non possint. Hanc confirmat tuetúrque meditatio et cogitatio, quae ipsa crebra est repetitio atque recursio imaginum, quatenus imagines aliorum sunt. Est et altera memoriae ratio quum quis affectionem illam et similitudinem rei alterius spectat et intuetur, cum temporis praeteriti cognitione quo

The second power and faculty is the preserving one, which receives, holds, and stores sensory impressions and traces. When an external sense applies itself to a subject, at the same time the internal principal sentient faculty approaches it too, and joins in perceiving and sensing the thing. When the senses are stimulated by things outside, they receive phantoms and emanations sent out by them, which then incite the internal sensory power. This power then holds and places in its record the forms and semblances of things provided by the senses. The things pass by and away: the forms and semblances stay in place longer, and are preserved as though carved in stone, the evidence being that the special ["ille"] sense comes to recognize and perceive abstract things at this point, as though their guardianship had been entrusted to its care. These phantoms and emanations of things are [P97] branded and carved on the brain, and are made an object of the faculty that imagines ["fingit"], like external sensory things. The external qualities arouse the senses, and the internal qualities the faculty. Then there is another faculty aroused by them [apparently by the external qualities] that is called the imagining one,¹¹ and is the third of the internal ones; it grasps the emanations presented to it. And there are three components in sensation: the thing presented, the sentient power, and the action that comes into play from their encounter; in just the same way this account will consist in three components: the phantom, the faculty of fashioning, and the action itself, by which in isolation from external things the faculty concerns itself with the phantom.¹² This is properly called "effiction," that is, the motion of the faculty around the mere phantoms and traces of things. Out of their confused mixture it produces much that had not come before the senses, such as flying people or winged oxen, and it differs in this from the previous faculty. Hence, since it becomes involved in many things never perceived by the senses, and after a fashion imitates the power of reasoning, Aristotle includes it in the generous name of intelligence.

Now the phantoms of things either quickly vanish, being lightly imprinted on the brain, or else, when placed more deeply in (so to speak) stores, are long preserved intact, like dispositions and characters; this preservation of images, which I mentioned earlier, is memory, which is regarded as unreliable in children and in the elderly: in children through inability to retain the imprint of images, and in the elderly because they cannot take them in. The imprint is reinforced and guarded by reflection, which is frequent returning back to the images, so far as they are the images of other things.

There is another pattern of memory when someone views the disposition and likeness of a second thing, with knowledge of the past time when the

facta est impressio: tum enim meminisse dicitur, ipsáque spectandi actio memoria est, sed ratione, vt dixi, diuersa, illa siquidem quòd imaginem conseruaret, haec verò quòd ex imaginis apprehensione rem ipsam repraesentet. Illa permissio et affectio quaedam est, haec verò actio: aut si dicere mauis, illa memoria est patiens et sustinens, haec verò agens. Vnde perspicuum esse potest inter bruta ea duntaxat meminisse, quae sensum et notitiam temporis habent, et quae simulachro spectato, sentire possunt se aliquando rem ipsam nouisse. Rursum eandem animae partem tempus cognoscere et meminisse, ea autem sentiens est anima. Haec tamen non propriè et per se tempus sentit, sed quatenus motionem et effectiorem agnoscit, quam tempore aliquo acceperat. Sic igitur definiri possit, Memoria est rei absentis per imaginis spectationem, cum temporis praeteriti cognitione repraesentatio. Fit autem haec memorandi facultate concita stimulatáque ab imagine, quatenus imago est exemplárque suum refert. Itaque vt omnes sentientis animae interiores facultates functionésque in summam referamus, externarum rerum simulachra hausta è sensibus in principem intimúmque sensum commeant. Horum beneficio princeps sensus res externas cognoscit, discernit et iudicat, eoque munere vis discernendi se exhibet atque promit. Simulachrorum si altior fiat impressio, tum conseruatrice erit memoria, cuius facultas conseruandi ex cerebri constitutione intelligi potest qualis quantáque sit. In spectra et simulachra princeps sensus incumbens, si seorsum illa versat spectátque vt nihil praeterea externarum rerum tractet, tum fingere dicitur, et ipsa sentiendi actio effectio est, quam propria fingendi comminiscendíque facultas exprimit. Si verò illa non in se consideret, sed vt simulachra et imagines externarum sunt rerum, tum meminisse dicitur, ipséque actus memoria est, propria memorandi facultate completus. Haec omnia in sensu primario insunt, neque alterius partis animae aut cerebri est effectio, alterius verò memoria, sed in subiecto eodem insunt et eiusdem partis animae functiones. Vnde intelligitur eos ab antiqua celebríque philosophia defecisse, qui vim illam ad fingendum aptam cerebri parte priore, memoriam posteriore collocarunt. Nam vtraque totius est cerebri, in cuius toto corpore fusa est princeps sentiendi anima. Sed de his posthac fusiùs. Satísne videmur omnes sentientis animae facultates connumerasse, áne praeter illas quaedam sint quibus somnum capimus et dormientium irrepant insomnia? Planè constat somnum et insomnia animantibus tanquam munera propriásque functiones attribui: at nequaquam his obeundis aliae quaedam sunt facultates. Nam somnus et vigilia plurimùm inter se distant,

imprint was made. Then he is said to remember, and the very action of viewing is remembering, but on a different basis, as I said; the first meaning is to preserve the image, the second is to reproduce the thing itself by grasping the image. The first is a sort of experience, the second is an action. Or, if you prefer, the first is passive sustaining memory, the second is active memory. This can make it clear that the only brute animals that remember are those that possess sensation and awareness of time, and that can sense when they have viewed a phantom that they once knew the real thing. Once more: it is the same part of the soul that recognizes time and that remembers, and it is the sentient soul. However, it senses time not specifically and spontaneously, but inasmuch as it recognizes motion and an effect that it had sometime received. So it can be defined thus: memory is the reproduction of an absent thing through the viewing of an image, along with realization that the time is past. It happens when the faculty of memory is aroused by the image, so far as it is an image and recalls its original. And so, to sum up all the internal faculties and functions of the sentient soul: the phantoms of outside things derived from the senses make their way into the main inmost sense. It is thanks to them that the main sense is acquainted with outside things and distinguishes between them, and the power of discrimination displays itself by this function. If the imprint of phantoms gets deeper, then memory will be retentive, and the sort and extent of its retaining faculty can be understood from the character of the brain. While the main sense applies itself to phantoms, if it devotes its attention to them separately to the exclusion of all outside things, it is said to imagine, and this same action of sensing is “effiction,” which the special faculty of imagining and recalling produces. But if it contemplates them, not in themselves but as phantoms and images of outside things, then it is said to remember, and this action is itself memory, accomplished by the special faculty of remembering. All these are present in the primary sense, and it is not true that “effiction” belongs to one part of the soul or the brain, but memory to the other; both are in the same subject and are functions of the same part of the soul. Hence it follows that those who located that power to imagine in the front part of the brain, and memory in the back part, had deserted an old famous school of thought; each belongs to the whole brain, and the main sentient soul extends over the whole body of the brain. But more detail on this later. Does it seem that we have sufficiently reckoned in all the faculties of the sentient soul, or are there further ones by which we get to sleep and by which sleepers’ dreams steal in? It is clearly established that sleep and dreams are functions peculiar to animals, yet there are no other faculties for achieving them. For sleep and wakefulness differ

et veré opposita sunt, haec quidem vt actus est, ille huius est [P98] priuatio: quare et eodem vt subiecto recipiuntur consisténtque, et vnus eiusdémque facultatis erunt. Cuicumque sensus inest, eidem et vigilia et somnus inest. Sensus quidem incitatio et motio est vigilia, illius autem vinculum et quasi carcer somnus est et immutabilitas. Caeterùm non vnus cuiuspiam priuati sensus affectiones hae sunt, sed primarij illius et communis, quo sopito necesse est reliquos etiam sensus consopiri, et tanquam satellites eius affectioni accumbere. Itaque quum primum illud sentiendi instrumentum nempe cerebrum, ex lassitudine aut longis excubiis impotens et incontinenens sui redditur, caeteris officinis simul defessis, necessariò somnus obrepit, in quo vacationem quandam feriarum vice habent sensus omnes, quòd eorum vires durare et sufficere operi non poterant. Quamobrem necessarius est cunctis animalibus ad incolumitatem salutémque datus et ad quietem. Similis propemodum et insomniorum ratio. Nam quum sit insomnium visum id et simulachrum, quod ortum et profectum à sensibus in somno animalibus se offert et obuersatur, id eiusdem partis animae eiusdémque instrumenti esse debet atque somnus, et qua parte dormit animal, eadem somniat. Dormit autem somnùmque capessit communi et principe sensu: huius ergo erunt insomnia, non vtique quatenus sentiens est, sed quatenus cogitatione fingit, et euagantibus simulachris lacessitur. Interpellatur vis illa fictrix motione et impulsione positarum imaginum: idque maxime noctu et dormientibus, quo tempore absolutis sensibus iisque functionum suarum vacationem habentibus, minima quaeque simulachrorum vestigia aduolant conflúntque ob fingendi vim: quae per vigilias sensibus opere vario detentis, et mente viuís cogitationibus obruta, offunduntur suppressunturque.

De appetitu et mouendi facultate. Cap. IX.

SUPRA SENTIENDI cognoscendíque vires alia quaedam est vis appetendi, quam et appetitum dixerunt, clara quidem et aperta functione se promens. Nullum enim animantis genus est, quod non aliquando impetu atque perturbatione incitetur, quod non rei cuiuspiam desiderio pulsetur et aestuet. Ea illius interior agitatio et animae motus, appetitio quidem est, Graecis ὀρμή appellata. Huic nihil commune intercedit cum reliquis functionibus interioribus, sed à singulis dissidet, à discretione, memoria, et effictione, quanquam eas, praesertim verò effictionem, naturali quodam instinctu consequitur. Quocircà et facultas quae illius est effectrix, à caeteris distabit, easque tanquam assecla

greatly from each other, and are really opposites; wakefulness being an action, sleep is a [P98] deprivation. And so, being within the same subject, they belong to one and the same faculty. In whatever [creature] sensation resides, wakefulness and sleep are there too. The stimulating and moving of sensation is wakefulness, but sleep is a sort of prison for sensation, and the absence of change in it. But these are not dispositions of some single isolated sense, but of that main general one: when it sleeps, the rest of the senses must fall asleep too and dispose themselves beside its state [“affectioni”], like henchmen. And so, when that primary instrument of sensation, the brain, gets weak and unrestrained because of weariness or long wakefulness, and the remainder of the workshops are weary at the time, sleep has to steal in; during it all the senses have a sort of leisure serving as holidays, because their powers could not hold out for their task. This is why it has to be provided for all animals, for their safety, health, and repose. Practically similar considerations apply to dreams. Since a dream is a vision and phantom that originates from the senses during sleep and presents itself to animals, it must belong to the same part of the soul and the same instrument as sleep; an animal dreams with the part that it sleeps with. It sleeps and engages in slumber with the main general sense, to which dreams will belong too, not just since it is sentient, but since it makes up things by reflection, and is stimulated by wandering phantoms. That imagining [“fictrix”] power may be impeded by the motion and impact of images set before it, especially during the night and in sleepers, at a time when the senses are on their own and on holiday from their functions, and all the tiny traces of phantoms flit before the power of imagination. During wakefulness, with the senses occupied in diverse activity and the mind enveloped in lively thoughts, these phantoms are overlaid and suppressed.

Chapter 9. Appetite and the faculty of movement.

IN ADDITION to the powers of sensation and knowing, there is another power, the power of seeking, which is also called appetite, displaying itself by its obvious function. Every kind of animal is sometimes stimulated by a disturbing urge, and violently assailed by desire for something. Its internal disturbance and its soul's motion is an appetite, called *horme* by the Greeks. It has nothing in common with the remaining internal functions, differing from each of them, from discrimination, memory, and imagination, though it follows upon them (especially upon imagination) by a sort of natural prompting. Consequently the faculty that produces its effect will differ from the rest, and will hang on behind

comitabitur, erítque sentientis animae summa atque suprema facultas, quae caeteris tanquam finis aut princeps insideat. Neque verò solùm hominibus, sed et beluis et stirpibus et inanimis sua quaedam inest appetio, vt nihil prorsum natura constare possit, quod non appetendi facultas impellat. Caeterùm id lato peramplóque discrimine: quandoquidem et stirpes alimentum proliciunt, et omnia generis cuiuscunque sint inanima proprio quodam motu aguntur, naturali appetitu concitata. Eodem et corporis vnaquaeque particula, siquando inanita fuerit, quod sibi familiare est alimentum ad se conuertit et rapit é [acute accent; a grave accent stands in 1554] venis. Huius summa vis in iecore considet, è quo tanquam è fonte in omne corpus diffusa, partium singularum vires sustinet. Alter ab hoc appetitus est communis ille sentiens, in cerebro situs, cuius tamen seminaria in alias quoque partes funduntur: maximos quippe ignes et incendia in testes pudendáque et in os ventriculi natura coniecit: in illos quidem libidinis (sic enim propriè appellatur, quanquam hoc nominis quandoque ad omne cupiditatis genus accommodant) in hoc verò liguritionis et cupediae. Coniecit et fomitem in cor qui ambitionis author est et excandescenciae. Atque duo hi fomites quum sint distincti sedibus, vnus cupiditatis, alter excandescenciae, vno tamen eodémque appetitu reguntur qui sentiens est et animalis. Vniuersum ergo animantium genus, sentiente illo communi appetitu ducitur, quem idcirco animale dixerunt: perfectionem enim hic et absolutionem continet omnis desiderij animalis atque bruti. Quicquid sensu vllo praeditum est, eius rei quam senserit comprehensione in appetitum ducitur, quo demum illam consecratur aut declinat. Hunc qui volet poterit ex ortus sui modo [P99] in complures species distrahere, vt alius ex iecoris virtute in pudenda et in os ventriculi diffusus, illecebram et incitamentum inde accipiat: alius ex cordis impetu et feruore, alius nempe sentiens ab his quae foris occurrunt stimuletur et excitetur: omnes quidem animales, sed variis orti principiis. Tertius praeter hos est appetitus, qui quid cum ratione desiderat, qui mentis rationísque consilio obtemperat, qui immanes et importunos ferinósque ardores refrenat et coërcet: ea est voluntas libera homini quidem familiaris, omnium princeps et regina. Appetitum animale acere solent et incitare quaecunque bona videntur, tametsi talia fortasse non sunt: at mentis appetitum ea duntaxat quae reapse et verè bona sint possunt incendere, solóque veri boni desiderio is capi et deliniri potest. Itaque quum tres omnino sint animae partes, si suus cuiusque esse debet appetitus, tres quoque erunt appetituum ordines, naturalis qui stirpium est: animalis siue brutus, qui beluarum:

them, and be the last and highest faculty of the sentient soul, which rests upon the others as fulfillment or leader. Not just people, but animals too and plants and inanimate things possess their own sort of appetite, so that nothing whatever can exist in nature that is not urged by the faculty of appetite. But this is over a very wide range [“discrimen”]: because even plants lure in their food, and all inanimate things of every kind are propelled on some specific movement, urged on by natural appetite. Under the same influence every part of the body, if it has ever got empty, directs to itself its familiar nutriment and seizes it out of the veins. Its highest power resides in the liver, from which it spreads out into the whole body, as if from a wellspring, supporting the powers of individual parts.

An appetite different from this one is that general sentient [power], based in the brain, that has nurseries extending into other parts too. Nature has inserted its largest blazes in the testicles and genitalia and in the mouth of the stomach: the blaze of lust (this is its proper name, although sometimes applied to every kind of passionate desire) in the testicles and genitalia, and gluttony’s in the mouth of the stomach. And into the heart, the originator of ambition and flaring rage, it has implanted touchwood. There are two of these touchwoods in different positions: one for lust, the other for flaring rage, but they are under the control of one and the same appetite, which is sentient and animal. Therefore the entire kind of animals is directed by that sentient general appetite, which people call animal accordingly; it forms the basis of the completeness of all the desire of animal and brute. Anything that is endowed with any of the senses is directed into appetite by its grasp of what it has sensed, and it is by appetite in the end that it makes its pursuit or strays from it. Anyone who wishes will be able to split appetite [P99] into several forms according to the way it arises: one is distributed from the excellence of the liver into the genitalia and the stomach mouth, to receive inducement from there; another is aroused by the cardiac impulse and heat; another (the sentient one) by outside events; all are animal, but begun from different origins. Besides these there is a third appetite, which desires something in association with reason, which obeys the counsel of the mind and reason, which quells huge unseasonable bestial passions: this is free will, well known to humanity, the ruling queen of all. Everything that appears good (even if perhaps it is not) usually whets the animal appetite. But only what is really and truly good can kindle the mind’s appetite, which is won and soothed only by desire for the really good. There are in all three parts of the soul, and so if each requires its own appetite, there will be three grades of appetites: the natural, which plants have; the animal or brute, which beasts

tertius rationis particeps, hominum. Hoc enim praecipuo homo viget, quamquam est etiam reliquorum particeps. Rursum verò animalis appetitus, aut cupiditas est, nempe libido vel cupedia, aut excandescencia, aut eorum quae sensus annuntiauerit desiderium. Haec de appetitu satis: nunc de mouendi et progrediendi facultate. Animal omne moueri et incedere, atque sui iucessus [read “incessus” as in 1542 and 1554] finem quendam habere, cuius gratia moueatur, demonstrari hinc potest, quòd rerum omnium agendarum status quidam sit finis. Motionem et progressionem animal suscipit, vt rem eam consecetur quae speciem boni et iucundi prae se fert, aut eam declinet quae tristis et aduersa iudicatur. Quocirca triste aut iucundum finis est, cuius gratia animal motum intendit, persequens aut fugiens. Hoc quidem postremum attingitur et obtinetur, omnium tamen primum ad motionem inducit, huiusque initium affert. Immobile enim obiectum quum sit, primò sensum mouet externum, deinde primatem atque intimum, ab hoc verò cogitandi [read “cogitandi” as in 1542 and 1554] fingendique facultatem, quae quum rem subiectam vt iucundam et voluptariam apprehenderit, simul insurgens appetitus illius desiderio tenetur: atque hic si promptus est et efficax, confestim animal impetum facit vel ad motum vel ad actionem. Vnde hoc rectè vt alia plurima videtur Aristoteles demonstrasse, cognitionem et appetitum principia et causas esse actionis atque progressionis animalium, ab hisque animalia cieri concitarique ad motum. Caeterum quòd appetitum proximam causam statuatur quae animal mouet et conturbat, quòdque nullam insuper mouendi facultatem instituat, cui sit hoc muneris praecipuè concessum, non satis dilucidè singula videtur exequutus. Nam reuera mouens illa facultas est à sentiente et ab appetitu diuersa. Primùm enim vulgatum est et contestatum, alia sensus, alia motus esse organa, aliósque neruos: vnde obtingit eiusdem artus, velut cruris aut brachij, motum perire illaeso tactu, qui in omnem cutem fusus est: contráque tactum aboleri saluo motu et incolumi. Quinetiam motio diuersum quiddam esse intelligitur à sentiendi functione, omnisque sensus perpessione quadam et affectione accepta obiri solet: motus verò non nisi adnixa et roboris contentione. Quibus planè conficitur sentiendi atque mouendi non modò instrumenta, sed etiam obeundi rationes et efficientes facultates plurimùm dissidere. Quod si est, consequens est continuò animalem appetitum, qui à sensibus et cogitatione ducitur, illáque perpetuò comitatur, omnino à progrediendi facultate differre. Iam verò singula persequamur. Imperfecta animalia quae solo tactus sensu praedita vitam agunt stabilem, vt conchylia, ostrea, conchae: sensu quidem

have; the third, with a share of reason, is the human one. By this one particularly a human being thrives, although he has a share of the others too. Again, the animal appetite is either passionate desire (lust or gluttony), or flaring rage, or a desire for things the senses have heralded. This is enough about appetite; the faculty of moving along comes next.

The fact that every animal proceeds along, and that its advance has an aim for which it moves, can be proved from the argument that the aim of everything that gets done is some state of affairs. An animal sets about moving along to seek something that presents a form of a good and pleasant sort, or it turns away from something judged grim and injurious. So the aim is something grim or pleasant, for which the animal directs its movement, pursuing or fleeing. This is what is reached and secured at last, but first of all it prompts and starts the movement. Being an immobile object, it first moves the external sense, then the primary internal sense, and through that the faculty of thinking and imagination. When this faculty recognizes the subject as pleasant and attractive, appetite is stirred at the time and possessed by desire for it; if the appetite is speedily effective, the animal at once makes an effort towards movement or action. Hence Aristotle appears to have correctly shown this (like so much else), that knowledge and appetite are the origins and causes of action and of moving along by animals, and it is they that rouse animals to motion. But he declares that appetite is the proximate cause that moves and upsets an animal, and he establishes no further faculty of movement to which this function could be particularly handed over: these points he does not seem to have established sufficiently clearly. For in fact, that faculty of movement is distinct from the sentient one and from appetite. It was originally put about and maintained that there were different organs for sensation and motion, and that nerves were different [again]. This is how it happens that the movement of a limb (leg or arm) is lost but touch is intact in that limb, dispersed in the whole of the skin; and contrariwise, touch is abolished but movement is spared. Further, it follows that motion is a different thing from sensory function, and every sense is usually considered as received with a passive disposition, but a movement as received with effort and strain. This clearly establishes that not just the instruments for sensation and movement, but also the reasons for undertaking them and the efficient faculties are greatly different. If this is true, it follows immediately that the animal appetite, which is guided by the senses and by thought and continually accompanies them, is entirely different from the faculty of moving along. Now for the details. Imperfect animals such as shellfish and oysters possess only the sense of touch and lead a stationary life: they are engaged by

illa doloris atque voluptatis tenentur, et fingendi cogitandique facultatem, licet obscuram inexplanatamque, quemadmodum et animalem appetitum, acceperunt. At illa tametsi compuncta sese contrahunt et in angustum se adducunt, nequaquam tamen progredi compertum est, neque organa motus habere. Quòd si progredi non possunt, neque ad incesum facultatem habent. Quorsum enim haec data illis esset, sine nervis, sine musculis, sine vllis quae his proportionem respondent instrumentis, quae sunt ad motum perquam necessaria? Nunquid otiosam et inertem illam omnique opere et negotio vacuum? nunquid in tantis rebus natura committens fortuito atque frustrà illam ingenuit? Quaecunque igitur appetendi vis est in illis ea nulla ratione mouet. Quocirca praestat vim mouentem ab appetente [P100] et sentiente, quae semper comites sunt et coniunctae nunquam separabiles, seiugare, quòd eorum quae sentiunt animantium, alia mouentem vim habeant, alia huius sint expertia. Huc demum persuadendi necessitas ex iis accedit, quae perfectioribus animantibus ipsisque hominibus neruorum resolutione prehensis obuenire solent: illis enim motus periit, quum interiores animae vires plenè constant, atque adeò ipse appetitus. Contrà verò accidit furore aut delirio percitis: tum enim non mens, non memoria, non appetitus, sed neque sensus ipsi integrè valent: atque tametsi interiores omnes animae functiones laeduntur, incesus tamen firmissimus plerunque est, et constans musculorum robur. Ex quibus perspicuum est aliunde quàm ab appetitu progressum institui et gubernari, essèque mouentem vim ab appetente diuersam. Sed et hae sedibus disclusae apparent. Etenim mouendi facultas in totius cerebri corpore sedem habet, maximè in parte posteriore, quam Graeci *παρεγκεφαλίδα* vocant, à qua tum spinae medulla tanquam caudex, tum plurimi mouentes nerui ortum habent. Sentiendi verò et appetendi facultas parte cerebri priore domicilium habet, quam constat sentientes neruos, eosque molles in sensuum organa profundere. Non hinc tamen existimari velim promouentem illam vim, quam à sentiente loco ac sede disiunxi, ab eadem etiam substantia dissidere, tanquam ea sit pars animae diuersae sed totius sentientis summa vis est et vltima facultas quae seorsum collocatur, vti visus vel auditus. Ea autem quemadmodum omnes externae sentiendi vires, appetitus potestati subest, cuius imperio compulsa, continuo quacunque iussa fuerit corporis partem promouet. Qua autem ratione fieri possit vt vis ea quae mouet, sentientis animae sit facultas, deinceps aperiendum.

the sense of pain and pleasure, and possess the faculty of imagining and reflecting, unclear though it may be, and also animal appetite. But even if they contract and narrow themselves down when pricked, moving along is not seen, and they do not have organs for movement. If they cannot change position, they do not have the faculty for movement either. What point would there be in giving it to them, without nerves, without muscles, without any of the instruments that are analogous to these, which are indispensable for movement? Would it not be a useless idle faculty, without any task or business? Did nature, involved in such great matters, produce it by chance to no purpose? So any power of appetite there is in them does no moving on any basis. It is therefore best to distinguish the moving power from the power of appetite and of [Proo] sensing, inseparable companions though they are, since among the animals that can sense, some possess the power of movement and others lack it. In conclusion, further compulsive and persuasive influence is contributed in the end to this by what generally happens to the more perfect animals and people themselves when seized by paralysis of the nerves: movement has failed in them, while the internal powers of the soul are fully present, and appetite itself besides. The opposite befalls those smitten with a brainstorm or frenzy, when neither mind nor memory nor appetite nor even the senses themselves are completely well, and even though all the internal functions of the soul are impaired, the gait is mostly very steady, and muscular strength well preserved. This makes it clear that gait is started and directed from a source other than appetite, and power of motion differs from power of appetite. Their sites clearly separate them: the faculty of movement is situated in the body of the whole brain, particularly in the back part that the Greeks call *parencephalis*;¹³ out of it the spinal cord takes its origin like a stem, and then numerous motor nerves. But the faculty of sensing and of appetite dwells in the front part of the brain, which it is accepted is the source of sensory nerves (soft ones) to the sense organs. But I would not like it to be concluded from this that the propelling force, which I detached from the sentient location, is also separated from the same substance as if it were a part of a different soul; it is the highest power and final faculty of the whole sentient soul, and is located separately, as vision or hearing are. Like all the outside powers of sensation, it is subject to the control of appetite, which compels it to put in motion at once any part of the body when bidden. Next will be disclosed the basis on which it can come about that the moving power is a faculty of the sentient soul.

Quam unaquaeque sentientis animae facultas sedem habeat, quod agendi instrumentum: neque omnes omni inesse animanti. Cap. X.

FACULTATES EX operibus discerni, et suum cuiusque operis instrumentum haberi ad proprias functiones accommodatum, supra quidem in genere est proditum. At particulatim sentientis animae propria sedes propriumque instrumentum est cerebrum, quod abditum et reconditum ad interiores quaslibet functiones [read “functiones” as in 1542 and 1554] comparatum est, sed ratione varia latóque discrimine. Cerebri substantia mollis vel dura memoriae sedes est, et instrumentum excipiendis rerum spectris: eius temperamentum, quantitas, et figura, vnà cum insito spiritu, discernendi, cogitatione fingendi ac memorandi facultatibus inseruiunt, et propriè accommodantur. In appetitu autem exultat cerebrum et effusum laetitia gestit: sensui et motioni interiores sinus et capacitates quatenus receptacula sunt spiritus, pro instrumentis destinantur: duo quidem priores sensui, medius et postremus motioni, cui et glutia appellata, et ductus ille vermi similis, subsidio sunt, eo quem enarrabimus modo. At quoniam facultates opus suum foras depromunt, externis quoque adminiculis indigent, sed quae à communi illo cerebri fonte deriuentur. Visus, auditus, atque gustus foris quum sint, neruos habent concauos per quos vis influat: similes habet et olfactus quanquam intimus est: atque hi molles sunt omnes à priore cerebri parte nati. Tangendi sensus paulò durioribus instructus est, quos sexta cerebri coniugatio ad interiora viscera forásque ad cutem diffundit, nullius motus authores. Iam verò exquisitè duri sunt mouentes appellati, qui tametsi motum voluntarium non efficiunt, vim tamen motus effectricem in musculos deuehunt, qui propria sunt mouendi instrumenta. In his verò paulum insistamus, et scrutemur quae ratio esse possit, vt inter eos neruos quorum similis est structura, alij mouentes sint, alij sentientes. Et ne qui fortasse causentur alios è cerebro, alios à parencephalide et spinae medulla proficisci, eandem statuamus vtrisque originem. Quid causae est igitur cur eorum quae à cerebro nati sunt, hi ad motum accommodantur, ad sensum autem illi? Eadem vtrisque est origo, spiritus similis in hos influens, compositionem eandem facit Galenus: quatenam igitur sortitio haec est, quae discriminis ratio? Duriores (inquit) sunt qui mouent, molles qui sentiunt. At qui è sexta coniugatione in viscera, in cutem, et in corporis extrema porriguntur tangentes nerui, [P101] multò iis sunt duriores, qui in oculos è secunda coniugatione

Chapter 10. The base and the instrument of action that each single faculty of the sentient soul possesses: they are not all present in every animal.

IT WAS explained above in general terms¹⁴ that faculties are distinguished by their actions, and each of these has its own instrument adapted to particular functions. But in detail,¹⁵ the special residence of the sentient soul and its special instrument is the brain, which is constituted in deep concealment for some internal functions, but on a diverse basis and over a wide range. The brain substance, soft or hard, is the residence of memory, and the instrument for accepting the emanations of things. Its temperament, size, and shape, along with the spirit situated inside it, minister to the faculties of distinguishing imagining and remembering, and are suitably adapted. The brain lets itself go in appetite, and exults in the throes of joy. So far as they are vessels of spirit, its internal cavities are devoted to sensation and motion, as instruments: two in front for sensation, the middle and hind ones for motion; the so-called buttocks [evidently the corpora quadrigemina] and the passage shaped like a worm lend assistance in the way we will set out. But since the faculties deploy their performance externally, they require external aids too, but the aids that may be drawn from that general cerebral wellspring. Since vision, hearing, and taste are external, they have hollow nerves through which power can flow; smell has similar ones though it is internal, and they are all soft, originating from the front part of the brain. The sense of touch is endowed with slightly harder ones, distributed from the sixth cerebral pair to the internal viscera and externally to the skin; they are not responsible for any movement. But the so-called motor nerves are exceptionally hard, and although they are not the cause of voluntary movement, they convey effective motor power into the muscles, the special instruments of movement. On this point let us pause a moment and consider what reason there could be for nerves of similar structure to be some of them motor, and some sensory. In case people perhaps plead that some of them originate from the brain but others from the cerebellum and spinal medulla, let us establish the same origin for both. Of those that spring from the brain, why are some adapted for movement and others for sensation? Both have the same origin, a like spirit flowing into them; Galen supposes the same composition. What lottery is this, what basis is there for the difference? The harder ones, he says, are the motor ones, [while] the soft ones are sensory. But the nerves of touch from the sixth pair that extend into the viscera, the skin, and the extremities are [Proī] much harder than those that run out from the second pair

protenduntur motum eis praestituri. Neque id modò ex longo viae tractu, sed ab ipsa statim origine, quòd posteriorem quam illi originem acceperint. Quocircà tam variae huius facultatis causa non in mollitudinem aut duritiem referenda est. Quónam igitur aliò? in compositionem. Huius verò compositionis quatenam est ratio? dicam paucis, disseram pluribus. Cerebri corpus motu agitur assiduo, nullo tamen tangendi sensu praeditum: contrà verò quae idipsum ambiunt meninges immobiles per se sunt, praesertim quae crassa: tactu autem eae valent exquisitissimo: quae singula vt Galeni fide confirmata sunt, ita etiam vulnerata apertàque calua contrectantibus nobis sunt deprehensa. Haec autem morborum euentus plenius declarant, quòd in delirio et phrenitide (quae ipsa phlegmone est substantiae cerebri) nullus plerunque dolor affligit, multoque minus in sopore et lethargo, qui tamen cum putredine est: at si vel minima occasio aut humoris aut etiam vaporis acrioris in meninges effortur, grauis dolor excruciat: quae cerebri et meningum diuersam naturam commostrant. Atqui spina et nerui omnes vel eo authore medullam habent è cerebro, eamque meningibus conuestitam, quae singula talem vim et naturam habent, qualem ab exortu acceperunt. Quocircà necesse est medullam in spina atque neruis (tametsi ea non vt cerebrum motu agitur) vim duntaxat mouentem, eius verò membranas vim sentientem et tractabilem tum suscipere, tum aliis particulis conferre. Si enim corpus cerebri sensus est expers, multò magis quae in spina aut neruis est medulla. Vnde enim et qua conditione vim nouam accepisset? Aut quomodo cerebri corpus vim illis sentientem conferat, quam non habet? Itaque quicumque nerui et tangendi et mouendi vim obtinent, vtriusque functionis instrumenta sunt, parte tamen diuersa. Qui sentientes dicuntur, solius tactus, nullius autem motus authores sunt, quod genus ij sunt qui è sexta coniugatione in interiora viscera et in extimam cutem abeunt. Hi quanquam non à solis meningibus (vt nonnulli quondam censuerunt) producuntur, ab eis tamen substantiae suae plurimum receperunt, à cerebro minimum: statim enim à tenui meninge orti vt ad crassiorem appulerunt, multum incrementi, roboris et virium illinc asciscunt sibi. Quapropter tactum duntaxat, non item motum efficiunt. Contrà verò qui ex spina orti magnam cernuntur medullae copiam suo exortu continere. Ergo prior cerebri pars sensus, posterior verò motus principium est atque sedes, meninges autem tactus sunt origo: omnium autem animalium functionum efficiens

to the eyes, on the way to convey movement to them. This is not just because of the length of their course, but is so right from their start, because they originate further back than those eye nerves. Consequently the cause of a faculty as variable as this is not to be traced back to softness or hardness. Then to what else? To composition. But what is the basis of this composition? I shall give it in a few words and discuss it in more. The body of the brain is agitated by constant movement, but possesses no sense of touch; on the other hand the meninges that surround it are motionless on their own, especially the thick one. But they have an effective and very discerning sense of touch; Galen's authority confirms the details, and we have observed them by touching when the skull has been opened by injury. The occurrences in diseases make this more fully clear, because in delirium and phrenitis (which is itself a phlegmon of the cerebral substance) there is as a rule no distress from pain, and much less in coma¹⁶ and torpor,¹⁷ which is however associated with putrefaction. But if there is the least escape¹⁸ of humor or even rather pungent vapor into the meninges, severe torture occurs. This demonstrates that brain and meninges differ in nature.¹⁹ But the spine and all the nerves, even on Galen's authority [*"vel eo auctore"*], have their marrow²⁰ from the brain, and it is clad in meninges that each possess the sort of power and nature they acquired at their origin. Consequently, although the marrow in spine and nerves is not in motion as the brain is, it must receive and pass on to other parts just motor power, while its membranes do the same for sensory and tactile [*"tractabilis"*] power. If the body of the brain is devoid of sensation, much more so is the marrow in the spine or nerves. From what source and in what circumstances could it have received a new power? Or how could the body of the brain pass on sensory power to them without itself having it? And so all the nerves that hold the power of touch and movement are instruments of both functions, but with a different part. Those that are called sensory are responsible for touch alone, and not for any movement, and are of a kind with those from the sixth pair running out to the internal viscera and the surface [*"extimus"*] skin. Although they do not emanate just from the meninges, as some people once thought, they did acquire most of their substance from them, but very little from the brain. Just after their start from the thin meninx, when they touched the thicker one, they took on a major contribution of growth, strength, and powers from there. Hence they bring about just touch, and not movement as well. But on the other hand those that originate from the spine are seen to embrace a large amount of marrow at their beginning. Therefore the front part of the brain is the source and seat of sensation, and the back part of movement, but the meninges are the origin of touch; the efficient

est cerebrum suis meningibus conuestitum. Qui nerui multa medulla conferti sunt, mouendi instrumenta existunt, tangendi autem ij quos maiore ex parte meninges protulerunt. Hoc si exquisitiùs pronuntiandum est, motus voluntarij proprium organum est musculus: qui quum ex simplici carne, ex vena, arteria, atque neruo conditus sit, ex neruo tamen qui inter caetera principatum habet, cuique praecipua mouendi functio refertur accepta, vim omnem assumit. Hic in musculi principium, quod caput appellant, inseritur primùm in paucas portiones distributus, sed quae rursum in alias tandèmq̃ue in fibras praetenues diffindantur. Omnes rursum in musculi fine coeunt, vbi neruum parem atque principio referunt, qui aut in tendonem aut in os aut in membranam intruditur. His ita de instrumentorum ratione constitutis, promptum fuerit vulnera quaecunque paulò antè infligebantur eadem persanare. Itaque si mouendi facultas eandem cum sentiente substantiam est sortita, neque hae disiunctae sunt animae partes, cur non omnia quae sentiunt animantia vt rerum comprehensionem quandam et appetitum habent, sic etiam progrediendi vim sunt assequuta? Quia (inquam) motus instrumenta non acceperunt, quibus deficientibus necesse est et functiones et earum facultates deesse. Quanquam igitur tactu omnia praedita sunt animantia, quòd vnus ad salutem et conseruationem maximè sit necessarius, eoque dempto animal effugere non possit tractabilium qualitatū exuperantias, quarum occursu mors statim irruit: reliquis tamen sensibus qui boni cuiusdam et locupletioris notae, non necessitatis gratia conditi sunt, non omnia instruuntur animalia: imò verò ab eisdem homo quandoque tum ortus tum morbi vitio deseritur, quum ab idoneis instrumentis destituitur. Alia animantia solo tactu vigent, cui alia gustum, [Pro2] alia alios denique sensus adiecerunt. Interioribus autem facultatibus quia minus distinctam hae instrumentorum rationem desiderarent, plurima (vt antè dixi) constant animantia, sed quaedam obscuriùs, quaedam magis insigniter efficienterque. At verò progrediendi facultate ea duntaxat vigent, quibus spinae medulla, aut ei simile quiddam accessit. Haud dissimulanter hoc loco adeunda est, sed funditus euer tenda iuniorum prope omnium absurda et futilis opinio, quae memoriam cerebri ventriculo postremo, phantasiam verò, id est cogitandi fingendique vim prioribus collocauit. Haec ex Arabum factione primùm orta, nullis rationibus stabilita, partim sicta [read "ficta" as in 1542 and 1554] pueriliter, partim effutita temerè, ita demum iactationem habuit in populo. Verùm quae suprà productae sunt à nobis rationes, palàm faciunt memoriae atque imaginum facultates vna eadèmq̃ue essentia contineri, sede vna

cause of all animal functions is the brain clad in its meninges. Nerves that are full of marrow prove to be instruments of movement, but those mostly produced by the meninges are instruments of touch. If this needs putting more precisely, muscle is the particular organ of voluntary movement. Although it consists of simple flesh, vein, artery, and nerve, it derives all its power from nerve, which is preeminent among the rest, and to which exceptional motor function can be traced. This nerve is introduced into the beginning of the muscle, called the head, and divided initially into small portions, which are further split into others and finally into very fine fibers. They all combine again at the muscle's end, where they restore a nerve comparable to the initial one, and it is inserted into either a tendon or a bone or a membrane. With things established in this way about the theory of instruments, it will be easy to heal up all wounds that were being inflicted not long before. So if the faculty of movement has been allotted the same substance as the sentient faculty, and if these parts of the soul are not separated, why have not all sentient animals acquired the power of moving along, just as they possess some understanding of things, and appetite? Because, I say, they lack the instruments of movement, without which the functions and the faculties of the functions must be wanting. All animals are endowed with the sense of touch, it being the one sense outstandingly essential for survival and preservation, and its loss means that the animal cannot evade excesses of the tactile qualities; at their onset death comes on at once. But not every animal is provided with the rest of the senses, which are instituted for the sake of some benefit and a better endowed status, not from necessity. Indeed, sometimes a person is deprived of them through defect of birth or disease, when he loses the appropriate instruments. Some animals are active through touch alone, but others have added taste to it, and yet [P102] others the other senses. As I said before,²¹ since the internal faculties need a less definite sort of instruments, very many animals depend on them, but some of them depend less obviously, and some more conspicuously and effectively. But only those animals that possess a spinal cord, or something like one, are active with the faculty of moving along. There is a preposterous and pointless opinion of almost all the younger people, placing memory in the rear cerebral ventricle, but fancy (the power of thought and imagination) in the front ones. Let us not pretend to pass it by here; let us totally overthrow it. It was started by the Arab school, supported by no reasoning, partly a childish story, partly a thoughtless babble, and came in the end to be flaunted among the people. But the arguments we offered earlier make it clear that the faculties of memory and of images are associated with one and the same essence, stand firm on one base,

firmari, circa spectra eadem negotiari, similique vti instrumento corporeo, quamquam est efficiendi ratio diuersa. Quandoquidem fit nec rarè vt causa efficiens vna, eodem vsa instrumento diuersos idcirco promat effectus, quòd dissimiliter id adhibeat operi, aliterque vires intendat. Hoc si potest tactus efficere, vt antè proditum est, id ipsum multò facilius praestabit princeps ille intimusque sensus, qui quanquam in organo est corporeo, functiones tamen occultas obit potius accurata ingenij intentione et obseruatione ad res adhibita, quàm organorum ope. Omnes enim eae functiones in illius sunt potestate, quas dum vult exhibet. At non sic externae, quae quia expromptae sunt nec liberae, ab instrumentorum necessitate pendent. Quare occultas illas et interiores facultates, non est necesse sedibus et instrumentis diiungere. Si Aristotelis et Peripateticorum rationibus illi non cedunt, audiant saltem vniuersam Graecorum medicorum familiam, qui omnes ad vnum iisdem principiis informati, laesa memoria non modò occipiti, sed toti cerebro remedia adhibere iubent: id ratum habentes, partem animae φανταστικὴν quaecunque ea sit, hanc eandem et recordari et rerum impressiones conseruare. Pluribus non ago, quòd ipsa illorum declinatio ad libidinem prorsus efficta videatur. Quomodo autem fieri possit, quum sint illae facultates in eadem sede, vt vnus cuiusque actio impediatur aliis constantibus et integris, ex his quae de functionibus trademus fiet posthac illustrius.

De intelligentiae facultatibus. Cap. XI.

OMNIUM ANIMAE partium princeps ac regina, mens est ac intelligentia, qua praeditus homo vnus caeteris antecellit animantibus: quaecunque enim praestantiora edit opera, eorum effectrix est et opifex intelligentia. Res incorporeas ab omni que materia seiugatas et nudas, vniuersales rerum notiones atque formas, huius opera omnium animantium vnus homo cognoscit. Vnde statim huius essentiam simplicem esse, indiuiduam, ab omni materia et corpore abstractam abiunctamque deprehenditur: neque demum vllius instrumenti corporei opera indigere, alioqui particeps fieret corporis: hisque potissimum à sensu distare. Iam verò si instrumento corporis intelligentia non opus habet, neque profectò ei miscetur, neque ab eius qualitatibus afficitur, prorsumque impatibilis euadit. Itaque intelligentia simplex est, incorporea, separata, impatibilis, immortalis, atque aeterna, imitatione deo proxima, homini diuinitus et extrinsecus accedens. Omnis tamen eius quae in nobis fit actio atque cognitio (quam

concern themselves with the same emanations ["spectra"], and use a like bodily instrument, although their way of working differs. For not uncommonly a single efficient cause using the same instrument produces different effects, because it applies the instrument differently to the task, and exerts its powers another way. If touch can do this, as was stated earlier, it will be brought about much more easily by that main internal sense that does reside in a bodily organ, yet carries out hidden functions more by the application of meticulous mental effort and observation to the matter than by the aid of organs. All these functions lie within its capacity, and it reveals them when it wishes.

The external faculties are different: being out in the open and not independent, they must rely on instruments. Therefore it is not essential to distinguish those hidden internal faculties by their bases and instruments. If our antagonists do not yield to the reasoning of Aristotle and the Peripatetics, let them at least listen to the whole family of Greek physicians, who were all brought to one mind by the same principles, and command us in a case of loss of memory to apply the remedies not just to the occiput but to the whole brain; they took it as established that the imagining part, whatever it may be, is the same as the part that remembers and retains the impressions of things. I do not pursue things further, since our antagonists' vagary seems completely contrived for self-indulgence. Since these faculties are in the same site, how it is possible that the operation of each may be obstructed, with the others staying intact, will be made clearer later in what we say about functions.

Chapter 11. The faculties of intelligence.

THE RULER and queen of all the parts of the soul is the mind and intelligence; endowed with it, man on his own surpasses the rest of the animals. The author and craftsman of all his more notable achievements is intelligence. Through its agency man alone among the animals acquires knowledge of things incorporeal, bare of all material, the universal concepts and forms of things. Hence we at once discover that its essence is simple, individual, detached from all material and body. Nor, finally, does it need the agency of any bodily instrument, otherwise it would have a part in the body. In these points it differs particularly from sensation. Now if intelligence has no need of a bodily instrument, it surely is not mingled with it, nor influenced by its qualities, and turns out entirely impassive ["*impassibilis*"]. And so intelligence is uncomplicated, incorporeal, separate, impassive, immortal, and eternal, closely resembling God, divinely conveyed to man from outside. However, all its action and knowledge (which

etiam intelligentiam dicere solemus) ab hisce rebus tracta est quae sub sensum recidunt, hoc argumento, quòd quem natura caecum surdúmque progenuit, is non possit Geometriam edoceri, neque qui odoratu captus est, aut gustu, possit ullam de saporibus et odoribus cognitionem animo concipere, et qui non sentit, nihil discere, nihil intelligere. Quocirca ex spectris et imaginibus rerum externarum, quae omni materie spoliata communi sensu continentur, necessum est primas et simplices intelligendi notiones proficisci. Vt externarum rerum qualitates sensibus subiecta sunt materia, ita illarum imagines interiore sensu conceptae, atque ab omni corporea labe expurgatae, subiiciuntur intelligentiae. Haec autem in illas incumbens, intellectiones elicit, et de illis multa cognoscit, quae sensus mouere non possunt: ab imaginibus [Pro3] tamen primum ciitur, quemadmodum sensus à rebus externis. Ergo quum intelligentiae obuersantur purae imagines, si ex illis debent abstractae quaedam formae confici, necesse est facultatem adesse, quae illas materiae sordibus prorsus vacuas et absolutas excipiat, et tanquam thesauros conseruet. Solent Peripatetici hanc intelligentiam patibilem appellare, quae pro subiecto quodam et gremio data formis et notionibus excipiendis, illis quasi substernitur. Quoniam verò quicquid in rerum natura consistit, praeter materiam effectiorem et perfectionem demum consequitur, sine qua temerè et fortuito nasceretur: necessarium est patientem intelligentiam ab altera quadam perfici, quae dignior quodammodo quum sit et praestantior, agens intelligentia nuncupatur. Haec tota patibili intelligentiae immergitur intexitúrque, atque ex his tanquam ex materia et specie fit res vna. Itaque sentiens anima tanquam materia quaedam substernitur patibili intelligentiae, haec autem materia fit intelligentiae agentis, quae propriè et maximè debet species censi, et simplex formarum forma: ad quam quum natura processerit, non vltrà progressura receptui canit, nullam praestantior, nullam nobiliorem formam inueniens: caeterae autem quae illis suppare sunt, nunc materiae, nunc formae conditionem subeunt. Ex duabus naturis tanquam ex materia et specie ratio atque mens constat, ipsa quidem incorporea, impatibilis et immortalis, tota quidem diuinitus adiecta nobis. Hoc autem rectiùs accipi velim, nempe quòd intelligentiae agentis appulsu nulla fiat concretio, sed haec vna eadémque sit atque intelligentia patibilis, fiátque ex illis res simplex, quae tamen duarum rationes obtineat. Neque reapse intelligentia patiens alteram agentem tempore praecedit: nam simul ac rerum notiones

we usually call intelligence too) within us derives from the things that come before the senses; witness the fact that anyone born naturally blind and deaf cannot be taught geometry, nor can anyone without the ability to smell or taste conceive any acquaintance in his mind with tastes and odors, and without the sense there is no learning, no intelligence. Consequently the original simple concepts of intelligence must stem from the emanations and images of external things that have lost all material and are held in the general sense [*communis sensus*"]. The qualities of external things are the material presented to the senses; in the same way their images, received by the internal sense and purified of all bodily defect, are presented to the intelligence, which applies itself to them, extracts insights, and finds out much about them that cannot affect the senses. However, it is [Pro₃] primarily stimulated by the images, in the way that the senses are stimulated by outside things. Consequently, when pure images pass before the intelligence, if it is required to create abstract forms from them, there must be a faculty present to take them over when totally freed of the squalor of material, and to treasure them in security. Peripatetics generally call this faculty the passive [*patibilis*] intelligence, which is provided as a sort of refuge [*subiectum*] and lap for the reception of forms and concepts, and (so to speak) underlies them. Everything in nature finally achieves (besides material) accomplishment and completion, without which it would have been born without reason and haphazard. And so passive intelligence must be perfected by another one, called the active intelligence, since it is in some way worthier and more excellent. This is all buried in and woven into the passive intelligence; and from them, serving as material and form, a single thing is made. So the sentient soul underlies the passive intelligence like a sort of material, and the passive intelligence is material for the active intelligence, which should be regarded properly and entirely as a form [*species*"], and the uncomplicated form of forms. When nature has reached it, it is going no further, and sounds the retreat, finding no form that is more excellent and notable. The rest [of the forms, presumably], which are nearly their equals, sometimes take on the status of material and sometimes that of form. Reason and mind consist of two natures, material and form as it were, and is a thing incorporeal, can undergo nothing [*impatibilis*] and is immortal, the whole of it divinely assigned to us. I would like this to be more accurately grasped, that nothing composite comes into being through the influence of the active intelligence, but it is one and the same as the passive intelligence, and from them a simple thing is made, yet one possessing the bases of the two. In fact the passive intelligence does not precede the other one, the active one, in time; as soon as it has received the concepts of

acceperit, per illas cognoscit: sed vt accipiendi et agendi, sic et illarum intelligentiarum diuersa est ratio. Quascunque mens singulas et indiuiduas rerum imagines atque notiones materia liberas, intelligentia patibili exceperit, eas dein agente intelligentia tractans apprehendit, atque primùm quidem singulares, mox deinde vniuersas ex illis formas elicit. Hic duae iam se promunt intelligentiae facultates, vna patibilis, agens altera. Quoniam verò agens intelligentia non modò simplices illas rerum notiones apprehendit, sed etiam (quemadmodum in nobis ipsis experimur) multas in vnam componit, hincque alia affirmat, alia inficiatur, tertia quae istaec efficiat statuenda vis est intelligentiae, quam componendi facultatem appellant. Enunciatione composita tum deinde iudicare solemus, et decernere quid verum falsumque sit, quid bonum et honestum, quidve perniciosum: quae omnia efficit vna iudicandi facultas. Hinc demum ex aliis alia nectentes, quàm plurima complexione concludimus, sicque inductione aut ratiocinatione scientiam aut opinionem comparamus, idque eius facultatis opera quam ratiocinatricem appellant. Supra has omnes se extollit contemplandi facultas, quae sapientiae rerumque aeternarum studio tenetur. Quisquis autem illius amore et suauitate non satis illectus, ad res caducas ratiocinandi vim conuertit, omnèque studium ad humanas refert commoditates et vsus, is vice contemplationis, actionis sibi facultatem adhibet. Si quid autem rectè facturus est, aliam facultatem accerset sibi que iunget, quae consultandi est et deliberandi. Ita iis instructus si quam habet scientiam vel opinionem, bona consultatione ad domesticarum aut ciuiliū rerum administrationem conferat et accomodat, vt prudens inde dici consuevit: ita et prudentiae facultate tum maximè vtitur. Sin verò illas ad vilioris operis et artificij constructionem adducat, artēque sibi paret, artificem facultatem exhibebit. Hoc loco voluntas existit, non vtique simplex et temeraria, sed libera et quae boni cuiusdam opinione per consultationem ducta, quod bonum est et vtile seligit, vnde electio à quibusdam dici solet, quam Graeci προαίρεσιν, nos consilij facultatem appellamus: haec ab intelligentia non subiecto aut essentia, sed cogitatione duntaxat et definitionis ratione distat. Ex consilio et proposito rem vnamquamque persequimur, si bona ac utilis videtur: si verò tanquam mala reprobetur, eam declinamus. Hincque surgit effectrix facultas quae consilij conatus implet et exequitur, et qua ad rem persequendam impellimur: haec autem est omnium facultatum intelligentiae postrema. Memoriae et recordationis facultates non primùm et per se in intelligentia, sed in

things, it gets to know through them; but as receiving and taking action have different bases, so have these intelligences. All the individual images of things, and concepts free of material, that the mind has received by the passive intelligence, it next grasps by handling them with the active intelligence, and extracts from them first the individual forms and then the universal ones. Here two faculties of intelligence now present themselves: the one passive, the other active. The active intelligence not only grasps these uncomplicated notions of things, but also (as we learn from personal experience) assembles many of them into one, and then one power of intelligence corroborates, another is imbued [with them], and a third power is to be established to produce these results, which is called the assembling faculty. Then we usually judge next by assembling a specification, and determine what is true and false, what is good and honorable, or what is disastrous; all this the single faculty of determining does. Next, by linking one thing to another we draw a conclusion from a very long string, and thus provide knowledge or opinion by induction or inference ["ratiocinatio"], and do it by using the faculty called the inferring one. All these are surpassed by the faculty of contemplation, concerned with the pursuit of wisdom and eternal matters. Anyone who is not allured enough by love of its attractions, diverts his power of inference to transitory things, and directs all his interest to human conveniences and needs, makes use of the faculty of action instead of that of contemplation. And if he is going to do anything right, he will introduce and attach to himself another faculty, that of consultation and deliberation. Thus armed with these, he contributes and adapts any knowledge or opinion he possesses by sound deliberation to the running of domestic or civil matters, so that he has usually thus been reputed prudent; in this way he also makes the most use then of the faculty of prudence. But if he turns his faculties to the creation of less worthy skilled work, and gets himself a trade, he will display the faculty of craftsmanship. At this point there is a choice, not necessarily a simple hasty one, but a free choice that settles on what is good and useful after taking every sound opinion into account. Hence some people call it election, the Greeks call it *proairesis*, and we call it the faculty of deliberation; it differs from intelligence not in its subject or its essence, but just in its concern ["cogitatio"] and on the basis of definition. Each thing we pursue, if it appears good or of use, we pursue out of deliberation and intention. But if it is condemned as bad, we turn it down. Here there springs up the effecting faculty, which implements the efforts of deliberation, and urges us on to our pursuit; it is the last of all the faculties of intelligence. The faculties of memory and recollection are not primarily of themselves situated in intelligence, but in the

[P104] communi sensu collocantur, huiusque duntaxat interuentu ad intelligentiam pertinere possunt, quemadmodum nos posthac in his quae de functionibus tradentur, plenius disseremus. Ne autem certos instituti mei limites praetergredi videar, his summatim decursis quae propriè Philosophum decent, ad vnus vitalis animae facultates me confero.

De vitali facultate, quam Aristoteles eandem atque naturalem existimauit. Cap. XII.

EXPLICATURO MIHI vitalis nostrae facultatis substantiam atque praestantiam, quamplurima obuersantur inuoluta summèque ardua, quibus praeclari philosophi Aristotelis patrocínio corroborati, contendunt nullam eiusmodi vim in nobis seorsum insidere. Is enim quum omnes animae partes atque facultates sigillatim numerando percenseret, hanc omnino tanquam nulla seorsum esset, praetermisit, statuens nimirum naturalem vim omnium primam, cunctorumque viuientium communem, quam eandem nullo nominum discrimine, nunc altricem, nunc vitalem appellat. Huius enim prospero fauore et praesentia, nutritio atque vita in cunctis manet, perit autem dum illius benignitas se subtrahit. Vitam quidem nutritione accretionèque definit, quòd vsque eo dum vita erit, nutritio quoque perstabit, hac autem deficiente, vita pariter tolletur. Itaque si eo authore vnum idèmq̃ sunt vita et nutritio, itèmq̃ viuere ac nutrirì: quaecunque facultas corpus alit ac sustinet, eadem vitam quoque tuetur, neque à naturali diuersa est vitalis facultas. Quinetiam insitum calorem cuius subsidio natura omnia concoquit corpùsque nutrit, sine quo non possunt animalia, sed ne stirpes quidem consistere, vitalem appellat, quòd inde sit omnium viuientium ortus, et vitae permansio, quòdque eo deficiente, interitus sit omnium. Quanquam autem omnis vitae et interitus causam huic ipsi calori acceptam refert, quem inde vitalem et salutarem consuevit appellare, nullam tamen in eo vim collocat, quae à naturali sit diuersa: sed hanc vt omnium primam in eo vitali calore constituit, ita et vitalem iure dici contendit. Non enim hic calor opifex est functionum corporis, sed animae eiusque facultatum tanquam vehiculum et instrumentum, sine quo eae neque alimentum conficere neque aliud quicquam possint efficere, sed ne consistere quidem. Vnde intelligitur illic facultatem versari, vbicunque calor fuerit deprehensus. Atqui plurimum in corde hunc vigere et flagrare sensus confirmat,

[Pro4] general sense [“communis sensus”]; simply through its intervention they can come within the scope of intelligence, in a way that we shall later cover more adequately in the account of functions. To avoid the impression of exceeding the fixed limits of my plan, having summarily gone through the matters that are a Philosopher’s proper concern, I turn my attention to the faculties of the one vital soul.

Chapter 12. The vital faculty, which Aristotle considered the same as the natural one.

As I set out to explain the substance and excellence of our vital faculty, very numerous concealed and highly difficult matters passed before me, used by the distinguished philosophers who were fortified by the legacy of Aristotle, to maintain that there is no separate power of this kind in us. When Aristotle weighed up and enumerated all the parts and faculties of the soul individually, he passed over this one entirely as being nothing on its own, evidently establishing the natural power as the original one of all, and common to all living things; he calls it, without distinction of name, sometimes the nourishing power and sometimes the vital power. Through its well-disposed presence nutrition and life persist [singular] in everything, but pass away while its goodwill is withdrawn. It defines life by nutrition and increase, because as long as life is there, nutrition will survive too, but when nutrition goes, life will be removed along with it. And so, if in Aristotle [“eo auctore”] life and nutrition are one and the same thing, and living and being nourished are too, whatever the faculty is that nourishes and supports the body is the same one that stands guard on life, and the vital faculty is no different from the natural one. Further, he describes as vital that resident heat, by whose aid nature concocts everything and nourishes the body, and without which animals and even plants cannot exist; his reason is that from it comes the origin of all living things and the continuance of life, and when it fails, there is an end of everything. Although he traces the cause of all life and death to this particular heat, and used to call it “vital” and “health-giving” for that reason, he does not station in it any power differing from the natural power; but having established natural power in that vital heat as the first of all powers, he holds that it is rightly called vital too. This heat is not the fashioner [“opifex”] of bodily functions, but as it were the carrier and instrument of the soul and its faculties, without which they can neither produce nutriment nor achieve anything else, nor even exist. Hence it can be appreciated that the faculty is involved wherever the heat is to be found. The senses confirm

illíncque vbi plurimus est et vberimus, tanquam à fonte quodam in omne corpus diffundi atque deriuari. Qua constanti validáque ratione asseuerat vitam et facultatem, quae semper cum istius caloris integritate simul est, vniuersum quidem corpus sustinere, sed totam ex corde tanquam è fonte et principio quodam fluxisse, quod tum vitalis, tum naturalis facultatis prima sit sedes, primáque origo. Hoc visceris dignitatem et praestantiam luculenter declarare, quod omnium in corpore primum vita fruitur, postremúmque mortem oppetit. Deinde sedem quae in corpore medio est, dignam quidem haberi, et tutò sub pectore conditam, vbi arx vitae commodissima strui debuerat. Porrò autem in quo principe corporis loco et in qua eius loci particula vitalis et insiti caloris principium est, ibidem naturalem altricémque animam omnium quidem primam collocari: non enim haec potest citra caloris opem, aut alimentum conficere, aut corpus nutrire. Quocircà à perenni illo fonte caloris, nequit vita et prima nutriendi facultas seiungi. His demum tanquam consequens annectit, cor primam esse et summam conficiendi sanguinis officinam, híncque venas perinde ac arteria propagari, et in corpus vniuersum proferri. Quicquid virium cor in perfectis animantibus accepit, idipsum in exanguibus parti cuipiam tribui, quae cordi proportionem respondet: in stirpibus autem ei quae media inter radicem et stipitem interponitur. Sentientis porrò animae sedem eódem instruit [read "intrusit" as in 1542 and 1554], hac duntaxat ratione adductus. Animal omne qua animal est viuit, neque fieri potest vt id quod ei tribuit vt animal sit, non etiam eidem vitam conferat. Quocircà concludit quocunque id principio animal est, eodem quoque idipsum viuere, neque seiuncta haec diuersáque esse principia: alioqui [P105] enim vt duo principia, sic duae fierent cuiusque animantis animae, et vtrovis qualibet ex causa dissoluto et extincto, alterius ope animal etiamnum constaret atque viueret. Ex quo demum infert vnam eandémque eam substantiam esse qua id viuit et animal est: tametsi varia id diuersáque fit ratione et cogitatione, neque qua ratione est animal, eadem ipsa viuit. Itaque si in corde aut in alia parte quae huic proportionem comparatur, vitae fons et origo collocatur, ibidem est sentiendi principatus, quo animal omne consistit. Iam verò in quo sensus, in eodem voluptas et dolor inest, perceptiòque iucundi atque molesti, ex quibus cupiditas nascitur et appetitio. Praeterea ex sensu surgit cogitatio et comprehensio, ex hac autem et ex appetitione, incessus itióque animalis. Vnde planè et expeditè conficit omnes sentiendi, cogitatione fingendi, appetendi, mouendíque

that it blazes with most activity in the heart, and this being where it is richest, it is from that wellspring, so to speak, that it streams out into all of the body. On this consistent and compulsive reasoning, he states that the life and faculty that always coexist with the soundness of this heat maintain the whole body, but has all flowed from the heart as its spring and source, making the heart the primary seat and origin of both vital and natural faculty. This, he says, indicates luminously the status and preeminence of this organ, because it is the first in the body to avail itself of life, and the last to die. Then its central situation in the body is appropriate, and is hid in safety within the chest, the most suitable place for the citadel of life to be built. Further, the main situation in the body, and the part of that situation where the headquarters of the vital and resident heat is, is just the place where right at the beginning the natural and nourishing soul is lodged, a soul that cannot produce nutriment or nourish the body without heat's aid. It follows that life and the primary faculty of nutrition cannot be parted from that ever-running spring of heat. He goes on to add as a corollary that the heart is the primary and principal place of manufacture of the blood, and veins run out just like arteries from it and extend into the whole body. The supply of powers that in perfect animals the heart has received is just what in bloodless animals is allocated to each part analogous to the heart; and in plants it is interposed in between root and stem. Further, he inserted the seat of the sentient soul in the same place, following just that reasoning. Every animal is alive insofar as it is an animal, and it is impossible that what he bestows on it to make it an animal does not grant it life as well. Consequently he deduces that on whatever principle an animal is an animal, that is the one by which it lives, and that these principles are inseparable and the same. If not, and [P105] there were two principles, there would be two souls in each animal, and if either were destroyed from any cause, the animal would still remain alive through the aid of the other one. From that he concludes that it is by one and the same substance that an animal is alive and is an animal, even though this happens on a different basis and consideration, and an animal is not alive on the same basis that it is an animal. And so, assuming that the wellspring and origin of life is located either in the heart or in some other part analogous to it, that is where the supremacy of sensation is, by which the whole animal exists. But where sensation is, there pleasure and pain are, and the perception of what is pleasant and harmful, whence passionate desire and appetite are born. In addition, from sensation arise reflection and mental grasp, and from this and appetite arises an animal's movement along. Hence he demonstrates clearly and speedily that all the powers of sensation, of imagining by reflection, of appetite and of movement

vires è corde duci, externorúmque sensuum in capite quidem positorum originem cordi acceptam referri, omnésque tum mouentes tum sentientes neruos illinc tanquam à fonte primo deriuari. Ergo anima illis instructa facultatibus in corde potissimum quidem insedit, ex quo tamen in omne corpus aequabiliter se fundit, partibúsque singulis inhaeret. Hoc planè declarant animalium quae insecta vocantur desectae partes, et ab arboribus auulsi rami: viuunt enim pristinásque functiones etiámnum retinent, seruaréntque diutissimè si nutriendi instrumenta non deessent. Id planè argumento est partes has tantam in se animi vim habere, quantam et ipsa olim integra. At perfecta animantia et homines, non viliori et abiectiori conditione viuunt, quàm stirpes et insectorum genus. Ex quo fit, vt integri cuiusque viuentis vnica sit anima, quae vniuersa corpus vniuersum continet. Si dum id in partes distractum est, partium vnaquaeque propria anima regitur, fient tum complures animae, quae prius vnica fuerant. Quapropter in integro re ipsa quidem vnica esse dicitur, at potestate complures, quòd ex ea fieri multae possint. Vnica autem et simplex quae in nobis inest anima, dispares longéque dissimillimas functiones idcirco edere potest, quòd varias facultates et disparia partium temperamenta ad illas accommodat: quemadmodum vnus idémque artifex, variis instrumentis diuersa plerunque et dissimilia opera condit et reponit. Ea igitur est Aristotelis de partibus animae eiusdémque facultatibus, et de communi earum sede sententia, ex omnibus philosophiae monumentis deprompta: ita sibi quidem cohaerens suisque principiis consentanea, vt nullis argumentis, nulla disputatione quae de vniuerso sit genere, conuelli labefactaríque possit.

*Medicos Platonem sequutos, vitalem facultatem à reliquis
diiungere. Cap. XIII.*

CAETERUM SI singula diligenter studioseque spectabimus, in quibus maxima multóque certissima vis inest demonstrationis, non pauca sanè occurrent, quae planè vniuersa illa redarguant, commonstréntque luculenter, praeter duas animae partes, quae pro certis atque concessis receptae sunt, tertiam vitalem eámque diuersam haberi, cuius sit vnus sedes in corde. Perennis enim et constans deprehenditur in nobis cordis et arteriarum motio, cuius assiduitate perpetua est spirituum procreatio. Hanc autem cuiusnam facultatis opera fieri arbitrabimur? Non animalis, vt cuius motus omnis est ad arbitrium, qui orta defatigatione sensim ingrauescit atque demum intermittit: cordis autem et arteriarum motus non est in nostra potestate vt nobis pareat, sed continuatus

are drawn from the heart, and that the origin of the external senses located in the head is traced to the heart, and all the motor and sensory nerves originate from there as from their initial wellspring. Consequently the soul, provided with these faculties, resides especially in the heart, but from there distributes itself evenly over the whole body, and is attached to individual parts. This is made evident by detached parts of the animals known as insects, and by branches torn from trees: they are alive, they still keep their former functions, and would long retain them if the instruments of nutrition were not lacking. This clearly indicates that these parts have as much power of soul ["animus"] as they did when intact previously.

But the perfect animals and man do not live in a more contemptible state than plants and insect kind. Hence it follows that each intact living thing has a single soul, which as a whole is associated with the whole of the body. If, when the body is split into parts, each part is controlled by a soul of its own, then several souls will exist that had previously been a single one. Consequently, in the intact state the soul is described as single in reality, but several in potentiality, because many can be made from it. The single simple soul in us is able to discharge various widely divergent functions, because it adapts varied faculties and differing temperaments of the parts to them, in the way that one and the same craftsman, using various tools, creates and stores away works that mostly differ from each other. This then is Aristotle's view on the soul's parts and faculties, and on their common seat, produced from all the literature of philosophy; it is so consistent and true to its principles that it cannot be demolished by any argument of an overall kind.

Chapter 13. The physicians who follow Plato divide the vital faculty from the rest.

IF WE look with careful attention at the details, where the greatest and far the surest power of explanation lies, we will certainly find not a few that refute those general propositions ["uniuersa illa"] and prove luminously that besides the two parts of the soul that are certain and taken for granted, there is a third, a vital and diverse one, and it alone resides in the heart. The motion of our heart and arteries turns out to be permanent and incessant, and its persistence brings about the continuous generation of spirits. What faculty shall we regard as at work here? Not the animal faculty; its every movement is voluntary, and is gradually weighed down as weariness comes on, finally failing. But the movement of the heart and arteries is not ours to command, and goes on and on

nullius causae vi lacessitus, et qui nunquam interrumpi potest. Neque praeterea hic à naturali facultate regitur, vt quae corporis nutritioni duntaxat addicta est et mancipata, nec tam apertos motus solet expromere. Aut si hos profert in nobis, quid est causae cur non similes efficit in stirpium genere, in quibus tamen nihil tale conspicitur? Neque demum insitus et naturalis calor tantae motionis est author, tum ob eas quas modò percensui rationes, tum quòd is per se quum simplex sit qualitas, non potest esse efficiens causa motionis: aliàs enim naturam eum esse confirmaremus. Sentire quidem rectè videtur Aristoteles motionem illam ex materiae et refrigerationis necessitate quadam fieri: caeterum istaec necessitas, incitans duntaxat et impellens, non autem efficiens causa rectè possit existimari, sed aliam supe-[P106] riorem atque praestantiorē scrutari necesse est. Erit igitur in vitali cordis calore vis quaedam et facultas harum motionum, et aliorum quae posthac referam operum effectrix, quae vitalis quoque nuncupata, à naturali et à sentiente prorsus dissideat. In haec fortasse quum penitus introspexissent, quicumque sub duce Auerrhoide in hanc Aristotelis sententiam iurarunt, hac diligenti rerum obseruatione adacti sunt, vt vitalem eam facultatem intromittant, atque suscipiant, sed quam (ne violetur iusiurandum) modo quodam incomprehenso somnient veriùs quam cogitent, in altricis illius et naturalis facultatis genere comprehendendi. Itaque duas constituunt ei differentias, vnam vitalem, alteram altricem, iudicántque vitalem altrici in opem et subsidium fuisse additam. Hoc illi commento probabile quiddam afferre videntur, sed tamen Aristotelis mentem offundunt, qui vnam eandémque vim nunc altricem, nunc naturalem, nunc vitalem, consuevit appellare. At mihi cum illis controuersiae nihil est, qui eò iam adducti sunt, vt nobiscum concedant tres in nobis facultates consistere, naturalem, vitalem, et animalem, quarum gubernaculis corporis natura et integritas tenetur et cohaeret. Iam verò tempestiuum est demonstrare hasce tres, non modò cogitatione, sed re ipsa et essentia inter se distare, esseque seiunctas. Omnia enim quaecunque sic comparata sunt, vt possit eorum vnumquoduis vel laedi et labefactari, vel prorsus interire et extinguì, aliis constantibus et inuiolatis, disiuncta ea sunt, neque vnam eandémque substantiam complent. Atqui in osse, in cartilagine, cui secundum naturam firma sit constitutio, nullus inest sensus nulláque sentiendi facultas: vitalis tamen et naturalis insunt, quarum beneficio alitur, atque viuìt. Lethargus, [*sic*; comma] sensus omnes motúmque consopit, totámque vim animae sentientem stupidam reddit, reliquis integrè valentibus. Paralysis quamcunque partem vehementer prehenderit, sensu motúque privat, aliis permanentibus

without the stimulus of any cause, unable ever to be interrupted. It is not controlled by the natural faculty either, this being dedicated just to the nutrition of the body, and not given to bringing such manifest movements into play. Or, if it does produce them in us, is there any reason it does not do the like in the kind of plants, yet nothing of the sort is seen there? Finally, the resident and natural heat is not the source of such extensive movement either, both for the reasons I just gave, and because it cannot be the efficient cause of movement on its own, being a simple quality; otherwise we would prove that it is a nature. It seems that Aristotle is right to consider that what brings that celebrated movement about is a requirement of the material and a requirement for cooling; this requirement, which just stimulates, cannot properly be regarded as the efficient cause; another [P106] superior and more notable one must be searched out. So there will be in the heart's vital heat a power and faculty capable of these movements and of other achievements that I will recount later; it too is called vital, being totally different from the natural and the sentient faculty. All those who were led by Averroes to swear allegiance to this view of Aristotle, perhaps after profound examination of these points, were coerced by their careful study to adopt this vital faculty; but to avoid violating their oath, they had to dream (which puts it more precisely than saying that they worked it out) in some unintelligible fashion that it was included in the kind of the well-known nourishing and natural faculty. Thus they establish two different sorts for it, one vital, the other nourishing, and decide that the vital got added to the nourishing for its assistance. They seem by this fabrication to be contributing something plausible, but they are obscuring Aristotle's meaning: he used to call one and the same power at different times the nourishing, the natural, and the vital. But I have no quarrel with them; they are now reduced to agreement with us that there are three faculties in us, the natural, the vital, and the animal, and by their guidance the bodily nature and soundness is held together.

Now is the time to show that these three differ from each other not just in thought but in reality and essence, and are separate. For all things so constituted that any one of them can be damaged or weakened, or entirely destroyed, while the others stay unchanged and unharmed, are distinct, and do not occupy one and the same substance. Nevertheless, in bone or cartilage, which have a strong organization according to [their] nature, there is no sensation nor sensory faculty; but the vital and natural faculties are there, contributing nourishment and life. Torpor²² lulls all senses and motion to sleep, numbing the soul's whole sentient power, while its others stay strong. Any part that paralysis has strongly seized, it deprives of sensation and movement, while the rest persist that

quae partem non sinunt contabescere. Sicque multifariam vis sentiens aut omnino laedi potest, aut partem quampiam deserere, aliis in nullam offensionem incurrentibus. Caeterum in atrophiam, palam est ex nutritionis errore vim altricem incommodo detrimentoque affici, necdum tamen alias concuti. Nec profecto desunt qui iudicent partis cuiuspiam nutritionem sensumque prorsus exterminari, vita duntaxat superstite, quum nempe ea liquefacta in totum extabescit, solamque vitalem facultatem retinet, quae illius integritatem tuetur, obsistitque ne illa consumpta putredine dissipetur. Est enim putredo vitae adversa, neque aliud quam vita obsistit ne pars in perniciem agatur. Quicquid igitur nutritione sublata integrum praeterea manet neque putrescit, id sanè vivit, vitalique facultate sustinetur. Hinc ut faceret ita praeclare olim dictum fuisse animadverto, hanc vim datam esse corpori pro sale ne putrescat, quod haec una possit omnem interitus perniciem retundere, arcere, praecludere. Haec enim summa est illius actio, non ut corpus alat, non ut rerum occursum sentiat, sed ut vitam et integritatem conseruet. Quinetiam quum quis pestilenti febre male torquetur, affligiturque cordis dolore, vomitione, animi defectione, quumque pulsus obscurus et imbecillis deprehenditur, quis tum ambigere potest facultati in corde vitali, cuius haec sunt opera, negotij plurimum exhibere, aliis quidem aut nihil omnino, aut multo minus agitat? Ut enim alia morbi genera aliis solent facultatibus malum inferre, sic hoc maxime pestilens vitalem vim obsidet, oppugnat, atque demolitur. Itaque potest quaevis una facultas noxam et incommodum subire, reliquis aut nondum aut non peraeque laesis: quin fortasse potest in quapiam corporis particula vis animalis ex morbo perire, simul cum hac et naturalis, una superstite vitali, quorum omnium rationes posthac vberius afferemus. Vnde plane perspicui potest, tres illas non modo cogitatione, et (ut dicere solent) ratione, sed re ipsa propriaque substantia diiungi.

Tres animae facultates sedibus atque locis discludi. Cap. XIII.

NULLA VIS animae quae potissimum obstricta sit corpori, quicquam potest efficere citra instrumenti alicuius subsidium. Quum autem vel animae instrumentum, vel domicilium offensionem acceperit, necessum est profecto, aut ipsius quoque facultatis substantiam laedi, si inde originem duxit, [P107] quod plurimi confirmant, aut certe (quod in externis fit artificii) effectus contortos et deteriores reddi, praepediri que functiones. Quare si

prevent the part from wasting. And in this fashion the sentient power can be impaired in many ways or completely, or it can abandon some part, with the rest suffering no impairment. But it is evident that in atrophy the nourishing power is harmed because of derangement of nutrition, but the others are not weakened yet.

There are undoubtedly people who think that the nutrition and sensation of some part are totally abolished, with just life surviving, meaning that at the time the part has dissolved and is completely decaying, keeping the vital faculty alone, which guards its integrity and prevents its breakdown from being devoured by rot. Rot is an enemy to life, and life is the very thing that prevents the part's destruction. So anything that has lost nutrition, but in addition continues intact without starting to rot, is certainly alive, and is supported by the vital faculty. I note here the old saying, both witty and clear, that this power was given to the body as salt to stop rot, because it alone could repel and fend off all the damage of death. This is its crucial action: not to nourish the body, not to sense the onset of things, but to preserve life and integrity. Further, imagine someone tortured by a pestilential fever, beset by heart pain, vomiting, and fainting, the pulse feeling faint and weak; who can doubt that the vital faculty in the heart, of which these are activities, is closely involved, and the others are either not disturbed at all, or else much less so. Other kinds of disease usually inflict damage on other faculties; similarly this particularly pestilent sort assails and abolishes the vital power. And so any one faculty can suffer harm and inconvenience, while the rest are not yet, or not as much, affected; it is also possible perhaps for the animal power in some part of the body to perish from disease, and the natural one with it at the same time, while the vital one alone survives, and we will later present plenty of grounds for all this. Thus it can be clearly seen that these three are separate not just in thought and (as they usually say) reason, but in reality and in their special substance.

Chapter 14. The three faculties of the soul are separate in their seats and locations.

No POWER of the soul that is especially linked to the body can achieve anything without the aid of some instrument. And when either the instrument or the abode of the soul has suffered damage, undoubtedly either the substance of the faculty itself must be injured too, if it has originated from there [P107] (as very many people affirm); or else certainly its effects must be distorted and impaired (as occurs in works of art outside), and its functions hindered. So if the

cor vna est omnium facultatum sedes, quoties id iniuriam et incommodum accipiet, omnes hae facultates necessariò peraequè laedentur. Haec autem perspicuè falsa esse et inania, declarant quae in pestilentibus febribus aliisque venenatis morbis obtingere proditum est. Quin et posthac apertiùs erit, multis ex causis cor eiusque actiones affici, constantibus aliis viribus. Itaque tres eae quae sunt, non essentia modò, sed sedibus quoque et principatu disiectae sunt, neque in eodem possunt solio considerare. Quòd si earum opera et effectus magna cum cura et diligentia intuebimur, non operosum fortasse fuerit propriam cuiusque sedem designare. Perspicuè cernimus esculenta potulentaque in eas partes, quae sub praecordiis positae sunt, maximè in ventriculum illabi, vbi primùm concocta, deinde iocineris vi in sanguinem conuersa, alendo corpori fiunt idonea. Cerebrum etiam tanquam commune sentiendi principium à sensibus omnibus circumsederi quis non videt? eosque per somnum comprehenso cerebro quasi vinctos teneri, excitari autem et operam quemque suam conferre per vigilias liberato illo et soluto? At cor in somno semper cietur et agitur, nunquam facta intermissione officij conquiescit. Hoc si sensibus prima est efficiendi causa, cur non eorum functio similiter perpetua sit et continens? Conquassato compressoque vehementer cerebro, animans continuò sensus omnis motusque expers obtorpescit: cerebrique offensione fiunt obliuio, stultitia, deliratio, apoplexia, quibus tum principes tum sensuum praepediuntur actiones, ab hisque malis liberant quae cerebro, non autem quae cordi adhibentur remedia. Malè autem affecto iocineri aegrè corpus alitur, aliàs atrophia extabescens, aliàs corrupto humore turgidum, quumque ei visceri valetudinis curatio adhibebitur, altrice facultate corroborata ad salutem corpus omne reducetur. Nemo est tam delirus qui constantibus his malis velit facere medicinam cordi, aut hanc si fortè tentet, non hallucinetur, expectationemque suam decipiat. Itaque sensuum actiones in capite maximè, naturales in iis partibus quae sub praecordiis sunt, explentur ac vigent. Vbicunque autem eae plurimum eminent et apparent, ibidem consentaneum est vim et facultatem earum effectricem dominari, suumque principatum habere: nam hac ista ratione ductus etiam Aristoteles vitae principium in corde collocat, quod omnium primum viuit, postremum emoritur. Ex propriis igitur operibus, ex medendique ratione, alrix vis et naturalis in iocineri, animalis seu sentiens in cerebro, reliqua vitalis in corde constituenda videbitur. Nunc autem mihi liceat rei fidem iis ductibus confirmare, qui facultatibus ad proprias functiones subsidio veniunt: venae quidem

heart is the one seat of all faculties, all these faculties must be equally impaired every time it suffers harm. But that this is manifestly untrue and groundless is shown by what traditionally happens in pestilent fevers and other venomous diseases. Further, it will be clear later that many causes can bear upon the heart and its actions, without change in its powers. And so these faculties are three, and separate not just in essence but also in their seats and their dominance, and cannot occupy the same throne. If we examine their activities and effects with great care and application, it will perhaps not prove onerous to identify the particular seat of each. We see clearly that food and drink slip into the parts below the costal cartilages,²³ especially into the stomach, where they start by being concocted and then are converted to blood by the liver's power, and become suited to nourishing the body. The brain too, as anyone can see, being the common basis of sensation, is ringed around by all the senses; and when it is in the grip of sleep, they are held tethered, but when it is freed by wakefulness they are urged each to perform its task. The heart, however, is continuously stimulated during sleep, never taking a rest break from its duty. If it is the senses' primary cause of action, why do they not operate all the time in the same way? When the brain is violently shaken and squeezed, an animal instantly loses all sensation and movement and becomes unresponsive. The blow to the brain brings on oblivion, stupidity, delirium, apoplexy, which hinder both the main activities and those of the senses. Relief from these ills is given by remedies directed to the brain, not the heart. When the liver is in distress, the body is poorly nourished, sometimes shriveling with wasting, sometimes swelling with corrupt humor, and when a treatment for its condition comes to be applied to the organ, the reinforcement of the nourishing faculty will bring the whole body back to health. No one is mad enough to want to practice medicine on the heart for these persistent ills; any person who happens to try would be a crazy optimist.

And so the actions of the senses are fulfilled and thrive mainly in the head, and the natural ones in the parts below the costal cartilages ["*praecordia*"]. It is agreed that everywhere that they are particularly prominent, their power and effective faculty exerts ruling control; it is this argument that led even Aristotle to locate the origin of life in the heart, because it is first of all to be alive, and last to die. So to judge from their particular achievements and from the theory of healing, the nourishing and natural power will be seen to reside in the liver, the animal or sentient power in the brain, and the remaining one, the vital power, in the heart. I may be allowed now to strengthen the case by [reference to] the channels that assist the faculties in their particular functions: the veins for the

naturali, nerui animali, arteriae vitali. Omnes quidem quemadmodum et ipsas facultates ex corde nasci prodidit Aristoteles, nequicquam à mente sua, nequicquam à se ipse discedens: rectè existimans illic facultatem et partem animae figi debere, vnde illius instrumentum nasceretur, ductúsque deriuaretur. Quocirca quum arterias ex corde duci, omnémque pulsationem hinc eas accipere inter omnes conueniat, si praeterea neruos è cerebro, venas è iecore primam originem duxisse commonstrem, videbor etiam planum fecisse, illud domicilium esse animalis facultatis, hoc verò naturalis. Vt in arboribus vniuersóque stirpium genere, maiora minorum sunt principia, et truncus omnium amplissimus deorsum radices agit, sursum autem in ramos diffinditur, hi rursus in alios exiliores, dum tandem in tenuissimam sobolem vndique propagetur atque fruticetur: hínque vnus omnium consensus in trunco principium constituit, et eam vim quae stirpi moderans, alimentum trahit distribuítque singulis partibus: ita sanè in venis atque neruis statuendum videtur. Caeterùm vena caua quà cordi assistit multò quidem tenuior est, quàm vbi è iocineris conuexo emergit: quinimò hic in duos ramos diffinditur, quorum vterque duplo maior est eo, qui ad cor sursum irrepit: quod planè argumento est non è corde, sed è iecore primam venis originem esse. Huc accedit, è cauis regionibus interioréque facie, iecur venam ad portas emittere, quae serpens multiplici lapsu et erratico, complures riuulos tanquam radices effundit in ventriculum, in omentum et mesenterium. His autem (venae tametsi sunt) nulla intercedit cum corde communio [Pro8] aut societas, sed ne cum his quidem venis quae è iecoris facie conuexa emeruerunt: quare stirpium exemplo iecur venarum origo constituendum est. Ex quo intelligitur partem in stirpibus inter radicem et truncum interpositam, quam Aristoteles cordi comparauit, iecoris potius quàm cordis similitudinem speciémque gerere, vt in qua vis insit naturalis, eam prorsus exprimens quae in iocinere consedit. Postremò vt perfectis animantibus arterias è sinistro cordis ventriculo nasci animaduersum est, sic terrenis animantibus iisque vocalibus dexter ventriculus adiectus est, in eúmque inserta vena caua, vt inde erumpente reiectóque sanguine pulmones alerentur. Muta autem animantia, vt pisces omnes, dextro sinu defici atque destitui, omnium iudicia sensúsque confirmant, quòd aquatilia neque pulmones habent, neque vociferantur, neque spiritum ducunt. At nihilominus sanguine aluntur in venis recondito, ipsaeque venae omnium iecori sic affixae sunt, vt apertè

natural faculty, the nerves for the animal faculty, and the arteries for the vital faculty. Aristotle held that they all originated from the heart, like the faculties themselves, and in this he departed pointlessly from his own reasonableness and character, but was right to think that a faculty and part of the soul should be linked to the place from which its instrument originated and its channel proceeded. Consequently, since everyone agrees that the arteries spring from the heart and get the whole of their pulsation from it, and furthermore, if I show that the nerves derived their ultimate origin from the brain and the veins theirs from the liver, I suppose I have made it plain that the brain is the abode of the animal faculty and the liver that of the natural faculty. Among trees and the whole kind of plants, the greater are the sources of the less, and the trunk, the largest part of all, sends forth roots below and splits into branches above, which again split into thinner ones, until finally it burgeons all over into the slenderest shoots. Next, universal agreement locates the origin in the trunk, and also the force that controls the lower end [*“stirps”*] and pulls along and distributes nutriment to each part. It seems things are the same in the veins and nerves. But where the vena cava adjoins the heart, it is much thinner than where it emerges from the vault of the liver; further, it divides here into two branches, each of which is more than twice as large as the one that creeps up to the heart.²⁴ This clearly indicates that the ultimate origin of the veins is not from the heart but from the liver. In addition, from its hollow internal surface the liver sends out the portal vein, which snakes along in manifold meanderings and gives off several streams like roots into the stomach, the omentum, and the mesentery. These, veins though they are, have no connection or [Pro8] association with the heart, nor even with the veins that came out of the domed surface of the liver; therefore the liver is to be regarded as the origin of the veins, on the plant pattern. It follows from this that the part in plants between the root and the trunk, which Aristotle compared to the heart, displays the likeness and form of the liver rather than of the heart, being where the natural power resides, and developing completely the power that lodges in the liver. Finally, it is noted that in perfect animals the arteries emanate from the left ventricle of the heart, and in the same way terrestrial animals able to utter sounds have a right ventricle added, and the vena cava is inserted into it, so that the lungs were nourished by the blood ejected from it. But the mute animals, such as all fishes, are devoid of the right cavity, as the universal view and sensory observation confirm: aquatic creatures lack lungs, utter no noises, and do not draw breath. Nevertheless, they are nourished by blood hidden in the veins, and the veins themselves in all cases are attached to the liver in such a way that they visibly

hinc deriuari cernantur. In dextrum autem cordis ventriculum (vt quem non habeant) nec inseri, nec inde possunt educi. Quid quòd vena in piscibus vix cor attingit, potéstne inde exoriri vnde longius abest atque diiungitur? Eadem propemodum sunt rationum pondera in neruorum exortu, quos palàm est cor non attingere, neque ei vlla communione iungi: vt idcirco nemo (nisi qui in contemplandis rebus caecus fuerit) existimet à corde tanquam à principio eos emanare. At si diligenter cerebri structura animo sensuque lustrabitur, clarum erit et euidens neruos omneis sentientes illinc deduci, ortúsque sui primordia accipere. Si substantia spectabitur, eos cerebri tanquam surculos arboris partes esse, sed quae in extrema corporis progressae, tum viae longitudine, tum locorum per quos tractus est siccitate, mira soliditate durescant. Spinae etiam medulla vera cerebri soboles, quà foras excedit ampla quidem est, tantò deinde gracilior facta, quantò longiùs processit. Ex hac autem tanquam ex arboris stipite, quamplurimi vtrinque nerui adeò expressè et perspicuè diffunduntur, vt nisi sensuum fides et praestantia tollatur, haesitari non possit, omnes aut proximè aut medullae interuentu ex cerebri substantia prodiisse. Vetus olim fuit sententia quae ob duritiem eorum ortum meningibus, tum cerebrum tum spinae medullam circumplicantibus, acceptum referret. Ab his fortasse nerui omnes inuolucra quaedam acceperunt, medullae tamen (quae ramorum qui in arboribus sunt exemplo, intus inseritur) origo cerebri substantiae datur. Haec autem prima est et praecipua nerui portio, qua valente motio omnis conficitur, et qua laesa concidit. Ergo ex functionum proprietate, ex instrumentorum positu, ex ductuum ortu ac deriuatione, in promptu et ante oculos esse debet, vim et facultatem animae naturalem in iocinere, sentientem in cerebro, reliquam autem vitalem in corde, quasi in sede propria constitui. Quibus etiam confectum arbitror eas non modò simplices facultates, sed loco sedibúsque disclusas haberi.

Rationum quas aduersarij proponunt confutatio. Cap. XV.

AT IAM video Sophistarum veriùs quàm Aristotelicorum turbam his obstrepere, qui tametsi planè vident naturae functiones in iocinere, animales in cerebro, vt in ventriculo

spring from it. But they cannot be inserted into the right ventricle of the heart (since these creatures have none), nor be traced out from there. So a vein in fish scarcely touches the heart? Can it arise from somewhere quite far separated from it?

The weight of reasoning is practically the same over the origin of nerves; obviously they have no contact nor association with the heart; consequently no one supposes that they stem from the heart as their origin, unless someone gone blind with gazing at things. But if brain structure is carefully surveyed in mind ["*animus*"] and by observation, it will be obvious that it is from there that all the sensory nerves stem and receive the elementary stages of their origin. If the substance is examined, it will be obvious that these nerves are parts of the brain, as twigs are parts of a tree, but of a sort that on their way to the outer limits of the body harden with remarkable firmness, through the length of their path and the dryness of the parts along their course. The spinal cord, too, a real offshoot of the brain, is wide where it makes its way out, but proceeds to get thinner the further it goes. There are distributed from it, as if from the trunk of a tree, very numerous nerves on each side, so clearly and obviously that without taking leave of one's senses one cannot doubt that they all emerged from the cerebral substance, either directly or with the cord in between. There was once an ancient view that took their hardness as indicating an origin from the meninges that envelop both the brain and the spinal cord. It may be that all nerves acquired sheaths from these; but the origin of the marrow (which is embedded inside,²⁵ on the pattern of the branches of trees) is regarded as the cerebral substance. This is the primary and paramount part of a nerve; while it is healthy, all movement is accomplished, but collapses when it is impaired. From the particular type of its functions, therefore, the location of its instruments, and the origin of its channels, it must be immediately apparent that the proper residence, so to speak, of the natural power and faculty of the soul is established in the liver, that of the sentient power and faculty in the brain, and that of the last, the vital one, in the heart. I think this has substantiated that these faculties are not only simple but also separate in their locations.

Chapter 15. Refutation of the reasoning put forward by antagonists.

AT THIS point I see that a mob of Sophists (a more accurate term for them than "Aristotelians") are clamoring against these views; they do see clearly the natural functions in the liver and the animal ones in the brain, as they see

chylosin, et in oculo visionem: has tamen fateri nolunt facultatum esse sedes, vt neque neruos à cerebro, venas à iocinere proferri. Quid est causae cur ita censeant? quoniam iniquiunt non vt medici sensuum aestimatione de his iudicio decernimus, sed vna duntaxat ratione demonstratiua. Quomodo? Quia princeps Avicennas scriptum reliquit, Philosophos qui vires omnes reponunt in corde, omnia altiùs perspexisse, inuestigassèque rationes magis necessarias, medicos verò quae sensus duntaxat mouent sequutos, facultates illas sedibus distraxisse. O delirationem incredibilem! desipientis enim arrogantiae est argumentationis necessitatem sensuum authoritati antepone. Sed quid necessitatem dico, quum nulla in id necessaria argumentatione, sed ne satis quidem probabili adduci possint? Nunquid quod sensu comprehensum est, potest vlla ratione conuelli? Tanta est eorum in vnus opinione pertinacia, vt errare malint, et in controuersia concertationèque perpetuò versari, quàm synceram purámque [P109] rerum cognitionem capere: atque quum perspicuis dubia debeant illustrare, dubiis perspicua tollere conantur. Quenam autem est eorum tam firma constansque ratio? Cor quia nobilissimum est et vitae fons, idcirco animae omniùmque eius facultatum sedem esse et principium: cerebrum autem, iecur, ventriculum, reliquásque partes illarum instrumenta duntaxat esse: omnes in corde altissimis defixas esse radicibus, at illarum functiones aliis partibus alias comparere. Est igitur iniquiunt cor principium, quod omnes facultates sinu complexúque suo continet atque fouet, non autem principium edendae depromendaeque functionis. Hac interpretatione quam plerique quasi ex tripode dictam suspiciunt et admirantur, putant Platonis medicorúmque obseruationem Aristotelis argumentationibus reconciliare, sicque omnem esse controuersiam dirimere. Sed quam vanus et irritus hic labor, velle eos qui ex instituto distracti sunt, in concordiam adducere? Cor iniquiunt omnium est facultatum origo, quia nobilissimum. Quasi verò rex qui totius est imperij nobilissimus, omnium subiectorum vires in se vnus comprehendat: et quia penes illum sit omnis necis et vitae potestas, idcirco subiectis propriae vires non insint, quibus quae sua sunt procurent. Expendamus autem ponderemúsque diligentius controuersam hanc rem, et plenam dissensionis inter doctissimos. Si iecur et cerebrum non primariae sunt sedes, sed instrumenti duntaxat rationem acceperunt, hócne à conformatione et figura solùm habent, an etiam à temperamento? Ab vtroque (opinor) cauti nec incallidi respondebunt: caeterùm temperamento quàm conformatione plus effici: sanguis enim in iecore, et spiritus animalis in cerebro, à substantiae proprietate

chyfication²⁶ in the stomach and vision in the eye, but refuse to accept that these are the seats of the faculties, or that nerves are derived from the brain and veins from the liver. What makes them think so? Because, so they say, we do not make our decision in this field like physicians by the reckoning of our senses, but just by demonstrative²⁷ reasoning alone. How? Because Avicenna the Master left it in writing that philosophers who locate all powers in the heart have looked more deeply into everything and have searched out more compelling reasons, while physicians have followed where the senses alone lead them, and have parted these faculties from their seats. Unbelievably crazy! It is typical of stupid arrogance to prefer the constraint of a line of argument to the authority of their senses. But why say constraint, when nothing can be introduced into the topic by constraining argument, nor even by sufficiently plausible argument? Is there anything grasped by the senses that can be undermined by any reasoning? They stick so doggedly to one man's opinion that they would rather be wrong, and engage forever in wrangling, than acquire a sound and [P109] pure knowledge of things. When they ought to use what is lucid to illuminate what is debatable, they try to use what is debatable to eliminate what is lucid. What is their so strong and consistent argument? That the heart, being the grandest part and the wellspring of life, is therefore the seat and headquarters of the soul and all its faculties; the brain, liver, stomach, and the rest of the parts are just their instruments; they are all implanted in the heart by roots of great depth, but their functions are in evidence in other parts at various times. So the heart is, they say, the headquarters that holds and cherishes all faculties in its embrace, but not the headquarters for deploying function. Most of them take up this interpretation with respect as gospel ["*ex tripode dictam*"]; they think they are reconciling the practice of Plato and the physicians with the arguments of Aristotle, and in this way settling all dispute. But surely a fruitless task, to try to produce consensus where there is established divergence? The heart is, they say, the origin of all faculties, because it is the grandest part. It is as if a king, the grandest in all his realm, were to appropriate the powers of all his subjects to himself, and because the power of life and death lies with him, his subjects have no powers of their own to pursue their own interests. Let us weigh up this point rather carefully; it is debatable, and full of disagreement among the very learned. If liver and brain are not the main seats, but have taken on the role of just an instrument, do they possess it²⁸ simply from their shape, or from temperament too? "From both," I think they will reply, cautiously and shrewdly, "but more is done by temperament than by shape; blood is generated in the liver, and animal spirit in the brain, more by the special character of the

et à temperie potius quàm à conformatione procreatur. Quoniam igitur ex temperamento vis quaedam et facultas enascitur, quae causa est efficiens, in vnaquaque particula vt temperamentum, sic et ingenitam oportet quandam facultatem inesse, quae functionum eius est opifex. Hoc quidem et illi tanquam planè consequens fatentur: quum vitalem spiritum ex corde videant per carotides arterias in contextum admirabilem, et in cerebri ventriculos efferri, illícque in animale conuerti. Istaec autem conuersio vndénam et à quo prodiit? Nónne ex vi aliqua quae cerebro propria insideat et ingenita sit? Neque hoc illi diffitentur. Necesse est ergo hanc istam vim insitam quae spiritum gignit animale, animale quoque haberi: quí enim fieri posse intelligemus vt hoc aliud gignat, cuius vi nulla et potestate sit praeditum? Multi quidem aiunt hoc fuisse Auicennae decretum, ne dicam subterfugium, spirituum omnium vt certè facultatum vnā esse eandémque substantiam: atque quum ea sit vitalis spiritus in corde, portionem quae in cerebri ventriculos contendit, temperationem quandam adipisci obeundis animalibus functionibus idoneam. Hunc tamen spiritum vim nouam illinc nullam consequi, quae non antè fuerit, neque substantia, sed qualitate duntaxat mutari et noua constitutione, quae spiritum illum vitalem aliter atque prius versans ac praeparans, efficit vt ad functiones animales accommodetur, et animalis in eo facultas nunc primùm sese expromat. Prius enim huius facultatis substantia ei spiritui insidebat, quum adhuc in corde tenebatur, nondum tamen ea se functionibus exprimebat, quòd impedita esset nec rebus consentaneis et adiuvantibus instructa. Solers ista quidem et subtilis rerum notatio, sed tamen falsa nimis et fallax assensio. Spiritus dum in contextu admirabili atque in cerebro propriam temperiem mutauit, nónne simul substantiam et speciem mutauit? Si speciem nónne et facultatem? Aliàs enim nulla fuerit toto corpore spirituum specie distinctio. Quod si fatentur, neque vlla profectò fuerit humorum specie differentia, sed solo accidente distabunt, sanguis, lac, et semen. Et quicumque ingerentur cibi, non in ventriculo, non in iecore, non in venis, non in reliquo corpore, aliam quam in qualitate mutationem subibunt, erit vna eadémque omnium vbique substantia ac species, non eorum modò quae in corpore continentur, sed ipsarum etiam partium. Hoc autem quid aliud est, quàm rerum species ac differentias de medio tollere? quàm omnia in idem substantiae genus contrudere? quàm rerum ortus et interitus in naturae mundíque exilium agere? quàm omnia omnibus confusa permiscere ac perturbare? Quod si specie distant corporis partes, et qui ab illis conuertuntur humores, cur non item spiritus substantia et specie inter se distabunt,

substance and by the temperament than by the shape.” So, since out of the temperament a power and faculty originates (it is the efficient cause), in every small part there should reside both a temperament and an inborn faculty, which is the fashioner of its functions. Even my antagonists accept this as an obvious consequence; when they behold the vital spirit conveyed from the heart through the carotid arteries into the *rete mirabile*²⁹ and the cerebral ventricles, and there converted to the animal spirit. What is the source of this conversion? Is it not some power peculiar to the brain, resident and generated within it? My antagonists accept this too. So this remarkable [“*istam*”] resident power that generates animal spirit must be animate [“*animalis*”] too; how shall we regard it as possible for it to generate this other thing whose power and potentiality it entirely lacks? Many people say that this was Avicenna’s dogma (I might call it his hoax), that one and the same substance belonged to all spirits, as indeed to all faculties; and further, as this is the vital spirit in the heart, that the part making for the cerebral ventricles acquires a temperament suitable for undertaking animal functions. But, he said, this spirit gains there no new power that was not there before, and does not change in substance, but just in quality and in a new disposition [“*constitutio*”], which works on that vital spirit in a manner different from before, adapting it to the animal functions; the animal faculty in it now comes into play for the first time. Previously the substance of this faculty used to dwell in the spirit still contained in the heart, and did not express itself in functions yet, being hampered and without suitable resources. An ingenious and subtle explanation this, but assent would be too misleading. While spirit altered its particular temperament in the *rete mirabile* and the brain, did it not alter its substance and form at the same time? And if its form, why not its faculty too? Otherwise there will have been no difference in the form of spirits throughout the body. If they accept this, there will assuredly be no difference in the form of humors either, but blood, milk, and semen will vary only accidentally [“*solo accidente*”]. And in the stomach, liver, veins, and the rest of the body, all the foods that are taken in will undergo no change beyond that of quality. There will be one and the same substance and form for everything throughout, not just for what is held in the body, but even for body parts themselves. What is this but abolishing the forms and distinctions of things, thrusting everything into the same kind of substance, banishing the coming into being and extinction of things from nature and the world, muddling everything with everything in confusion?

But if parts of the body differ in form, and so do the humors transformed by them, why will not spirits differ too from each other in substance and form?

quos pa-[ΠΙΟ] lam est multò tenuiores esse, et facilè mutabiles, vt expeditius quàm illi partium quibus assidebunt, vim et conditionem subeant? Itaque consentaneum magis est, vt cerebrum à corde, ita animalem spiritum à vitali, specie atque substantia differre, diuersisque illos facultatibus teneri. Quicumque aduersa sustinere contendent, multis astricti vinculis, eò quo minimè volunt imprudentes reuoluentur. Quocircà multò melius quam illi et luculentius Alexander Aphrodiseius, quamuis impense Aristotelicae disciplinae studiosus, cerebro, iecori, ventriculo, reliquisque partibus proprias vires addixit, qui quum alias esse distinxisset quae famulantur et seruiunt, alias quae regunt et quasi dominantur, subiecit animae principatum in corde constitui, vires autem eas quae velut subiectae famulantur, in varias corporis partes disiici. Nam quaecunque ad animalis facultatis demonstrationem attulimus, eadem ferè ad naturalem et reliquas accommodari possunt. Quisquis igitur volet naturalem contemplationem medicis obseruationibus confirmare, omni deposita concertationis inuidia, tres animae facultates, vitalem, animalem, et naturalem, essentia, sede, instrumentisque discludat. Nunquam enim futurum est, vt qui eas turbulenta confusione connectet, quicquam in re medica vel dilucidè demonstraret, vel certa intelligentia et ratione comprehendat. Hinc videas non modò Alexandrum, sed reliquos propè omnes Aristotelis interpretes, vitalem facultatem à naturali discreuisse, alios inseruientes quasdam facultates membris assignasse, alios non vnā et eandem, sed planè diuersam instrumentis originem dedisse, indicium sanè vacillantis et fluctuantis opinionis tanta interpretationum varietas. Quamquam verò vnus Aristoteles admirabili scientia, atque iudicio, in caeteris ferè suspiciendus est, at à nobis venerandus, hīc tamen primus temerè fregit auctoritatem veteris disciplinae, atque vt nouam conderet, partes illas animae labefactauit atque peruertit, quas mirificè Plato erat amplexatus. Verebatur enim ne si illas cum Platone admitteret, multas in homine animas, et hunc multa esse animalia fateri cogeretur. In has autem ruinas atque salebras si Plato incidit, ne illas quidem Aristoteles vlla declinatione vitare possit et effugere, vt qui alteram animae partem immortalem caducam alteram instituat. Hinc Themistius vtrique opinioni impedimentum hoc accidere tradit, quòd non simplicem, sed concretam ex partibus animam dicit. Quid autem in his statuendum sit, paulò pòst fusius disseretur à nobis, quum animae substantia et integritas explicabitur.

They are manifestly [ΠΙΟ] much more rarefied and labile, so as to take on more quickly³⁰ the power and status of the parts in which they reside. And so it is more consistent for brain and heart, and animal and vital spirit, to differ in form and substance, and be occupied by different faculties. Anyone who will set out to maintain the opposite will be carried off by his rashness, heavily fettered, to where he least wishes to go. Consequently, Alexander of Aphrodisias did much better and more luminously than they. Though a devoted student of Aristotelian teaching, he assigned particular powers to brain, liver, stomach, and the other parts, and separated off some that are subservient from others that are in control. He added that the headquarters of the soul is established in the heart, but the powers that serve as subordinates are dispersed into various parts of the body. For whatever we introduced into the description of the animal faculty can generally be adapted to the natural one and to the others. So anyone who wishes to set aside all jealous wrangling and reinforce his view of nature by medical observations may distinguish the three faculties of the soul (vital, animal, and natural) by their essence, seat, and instruments. For there will never be a time when those who link these faculties in a stormy muddle prove anything in medicine clearly, or grasp it with trustworthy intelligence and reasoning. You may see here that not just Alexander, but almost all the other interpreters of Aristotle, distinguished the vital faculty from the natural one; some of them assigned subordinate faculties to the limbs; others granted not one and the same origin to the instruments, but a quite different one; such various interpretation clearly betrays a shaky indecision. Aristotle on his own, a man of marvelous knowledge and judgment, is usually to be respected among the rest [of the world], but for us a man to revere, though here he was rash to start violating the authority of ancient teaching; to set up new teaching, he overthrew and distorted those parts of the soul to which Plato had marvelously devoted himself. He was afraid that if he accepted these [parts] along with Plato, he would be compelled to agree to many souls in a man, and that a man was many animals. If Plato stumbled into this rutted devastation, Aristotle could not swerve to avoid it either, being the man who made one part of the soul immortal and the other transitory. Hence Themistius relates that there is this obstacle in the way of each view: he says that the soul is not simple, but composed from parts. We will presently discuss at greater length what should be made of these points, when the substance and wholeness of the soul is explained.

Quid vitalis facultas caeteris praestet et impertiat, in quibus insit, quo accedat ordine,³ quid vita. Cap. XVI.

Id quidem peruagatum vel apud idiotas omnium sermone percrebuit viuere stirpes, viuere animantia, viuere superos: hos quidem solius mentis agitatione, ista sensus impulsu, illas verò natura duce. Quum autem vnus homo naturae, sensus, mentisque viribus teneatur, sitque naturae vis altrix in iocinere, reliquae in cerebro, quid est quod [*sic*] duorum istorum conspiratione et mutuis officiis non satis gubernamur et conseruamur? Si omnis vitae functionum causa ad haec referri putetur, quid praeterea cor nobis additum est? qua impellente necessitate conditum? quatenam illius actio quam iecur et cerebrum non obeant? Aut igitur omnino id superuacaneum videtur, aut prima omnium facultatum sedes. Haec quidem sunt quae nonnulli inexplicabilia esse dixerunt et nondum comprehensa, quae tamen extricare et in perspicuam lucem proferre conabimur. Animantium genus naturalem et altricem vim cum stirpibus quidem habet communem, eamque positam in iecore: sed quae tamen praestantioris cuiusdam sit ordinis et dignitatis: omnem quippe nutriendi functionem animantia lege quadam et ratione perfectiore complent. Stirpi alimentum est succus impurus atque lutulentus è terra haustus: animanti verò id quod iam multiplici mutatione praeparatum est, vt olus, vt fructus, vt caro. Facili promptaque coctione et rudi quadam alimenti conuersione stirpes aluntur: animantes autem non nisi vtilis alimenti multifariam facta concoctione, qua longa rerum serie in sanguinem ac demum in corporis substantiam conuertitur. Quoniam igitur tam multiformis est in animantibus concoctio, [P_{III}] et alimentum id perfectionis assequitur quò nequit in stirpibus peruenire: necesse est omnino vim quandam praestantiorum in animantibus quàm in stirpibus nutritionem moliri, eamque aut generis cuiusdam esse praestantioris, aut acceptis aliunde viribus adiuuari. Hac ratione perfectis animantibus cor attributum est, cuius calor et facultas toti corpori maximè verò iecori et cerebro impartiretur, omniùmque functiones et munera compleret. At verò stirpibus quae solius naturae beneficio viuunt et vigent, vnica vis altrix obtigit eo sustentata calore, qui tanquam materia subiectus est. Hic porrò languidus est atque iners, in omnem stirpis substantiam diffusus nec facile dissipabilis, hoc indicio quòd arborum defracti, euulsi aut abscissi rami aliquantum viuunt, possuntque insiti reuirescere et fruticari. Sic profectò exanguia animantia quae naturae ancipitis sede stabili scopulis adhaerent, vt conchae: et quae sponte sua intimoque motu huc

Chapter 16. What the vital faculty provides and imparts to the rest, in what it resides, what status it reaches, and what life is.

THE WIDELY held view has been disseminated on everyone's lips, even among lay people, that plants are alive, so are animals, so are the gods; the gods are so by mental activity only, animals by the prompting of their senses, plants by the direction of nature. One human being is maintained by the powers of nature, the senses, and the mind, and the nourishing power of nature is in the liver, the rest in the brain; so what is to prevent us being adequately controlled and protected by mutual collaboration between these two [liver and brain]? If the whole cause of the functions of life is regarded as traceable to these, why are we given a heart as well? Under what compulsion was it made? What action has it that is beyond the liver and brain? It appears to be either entirely superfluous, or the primary seat of all the faculties. These are problems that some have called baffling and not yet understood, but we shall attempt to disentangle them and shed clear light upon them. The kind of animals possesses a natural nourishing power in common with plants, and it is located in the liver, but is one to occupy a higher status, because animals fulfill the whole function of nourishing on a more perfect principle and basis. A plant's nourishment is muddy juice drawn out of the earth, but an animal's is something prepared by manifold change, like vegetables, fruit, or flesh. Plants are nourished through easy quick coction and some crude conversion of nutriment, but animals require concoction of useful nutriment performed at many sites, which by a long sequence changes it into blood and ultimately into bodily substance. Concoction in animals is therefore so diverse, and [P_{III}] nutriment reaches a perfection it cannot attain in plants; it is absolutely necessary that a more excellent power should bring about nutrition in animals than in plants, and it must either be of some more excellent kind, or have the assistance of powers from elsewhere. A heart was assigned to the perfect animals on the basis that its heat and faculty would be shared with the whole body, but particularly with the liver and brain, and they [though singular verb] would discharge the functions of them all. But plants, which live and thrive thanks to nature alone, acquire a single nourishing power sustained by the heat that underlies it like a material; the heat is, furthermore, sluggish, dispersed into the plant's whole substance and not readily dissipated: witness the fact that broken, torn-off or severed tree branches live on to some extent, and if grafted can become green again and put out shoots. Undoubtedly it is the same with the bloodless animals such as shellfish that are of an ambivalent nature and cling to a firm base in rocks; and with those that proceed hither and

illuc promiscuè feruntur, vt apīs, formica, vermis, et reliquum omne insectorum genus, quorum resectas partes seorsum moueri conspiciamus: omnia quidem vitae suae calorem exiguum habent, eúmque toto corpore aequabiliter conserutum, neque in iis vlla est sedes cordi verè comparata, è qua hic calor quoquoersum in omnes partes influat et illabatur: his enim ita positīs, abscissae partes neque viuere, neque moueri possent. Contrà autem perfectiorum animantium partes, quum desectae continuò vita priuentur, argumentum est non ex se, sed aliunde influentibus viribus eas sustineri, neque proprio solùm calore vt stirpes, verùm etiam ascito gubernari, et supra vim iecoris naturalem, aliam ex corde vitalem aduenire. Porrò autem vitalis facultas animali etiam succurrit et opitulatur, quòd ei velut pabulum et materiam suggerat, ex qua demum spiritus profertur animalis. Hinc nonnullis existimatum est, vitalem animalis gratia potissimum conditam esse, quòd ei plus quàm naturali conferre videatur: quandoquidem praeter materiam vim etiam subiicit qua in opus excitatur erigiturque, vt citra cuius opem vis animalis qualiscunque fuerat ex semine producta, ignaua et languida oticaretur. Itaque haec omnium postrema rectè constituitur, quae in foetu dum vtero gestatur, tum obscuras vires ostentat, tum minimùm videtur necessaria: iam editus infans hac luce fruitur, ea pectus distendens deprimensque spiritum ducit ac reddit, nec tum exiguum opem fert cordi. Caeterùm haec ipsa vitalis facultas non modò caeteras omnes quum rudes adhuc et inchoatae sunt perficit, sed etiam easdem quoad viuūt animal tuetur, et ad agendum impellit. Id planè declarant arteriarum interceptiones, quae aut vinculis aut aliis quibuscunque causis opprimentibus inciderint: per has enim cordis aspiratione cohibita, mox repentè tanquam attonitum corrui animal. In syncope tantisper dum vitale robur corporis partes non illustrat, reliquae quoque facultates omnes pariter intermissionem faciunt: mox autem vt id excitatum reuixerit ac seipsum collegerit, omnes illae quasi recreatae recurrunt. Absonum autem et absurdum fuerit, existimare hoc exiguo tempore partes corporis ab omni vi et facultate destitui, in quod tamen discrimen Auicennas adducitur, et quicunque statuunt facultates omnes à corde illabi. Hoc igitur temporis articulo, particulis suae insunt propriae et ingenitae vires quemadmodum et cordi, sed quas tamen nulla vis princeps stimulet et incitet. At nihilominus si robur id vitale perdiu abest nec influit (quemadmodum quum praeceps et insolens syncope hominem tollit) inficiari nolim partium facultates

thither indiscriminately of their own volition and internal movement, such as the bee, ant, worm, and all the rest of the insect kind, whose severed parts we see moving separately. They all possess the slight heat of their life, packed evenly into their whole body, and there is no seat in them properly comparable to a heart, out of which this heat can flow out in every direction and to all parts. If they were thus arranged, severed parts could neither be alive nor move. On the other hand, since the parts of more perfect animals are at once deprived of life when cut off, the case is that they are supported not from their own resources, but by powers flowing in from elsewhere, and they are not controlled just by their own heat like plants, but also by imported heat, and another vital power from the heart comes in, in addition to the natural power of the liver. Further, the vital faculty too lends its aid to the animal one, by supplying it with, so to speak, food and material, from which in the end animal spirit is produced. Hence a number of people have held that the vital faculty was instituted especially for the sake of the animal one, because it is thought to contribute more to it than the natural one does. Besides material, it furnishes the power too by which it [the animal faculty] is stimulated to its task, a power without whose aid the animal faculty would take its ease in idle leisure, whatever it had been like when brought forth from semen. And so this [the vital faculty] is the last faculty to be properly established; in the fetus carried in the womb it displays imperceptible powers and seems barely necessary then. But when the newborn infant enjoys the light of day, this faculty dilates and constricts the chest, drawing breath in and out, and gives at the time no small aid to the heart. But this vital faculty does not just perfect all the others at a time when they are still rough and incomplete; it also guards them throughout the animal's life, and stimulates them into action. This is clearly shown by the blockages suffered by arteries when compressed by ligatures or any other cause: these interrupt the heart's respiration, and soon the animal suddenly collapses as though struck by lightning. In syncope, for the period that the vital strength does not embellish the bodily parts, the other faculties too have a similar respite. But presently, when the strength has been stimulated to come back to life and gather itself, all the faculties return as though made new. It will turn out inconsistent and absurd to suppose that in so short a time the parts of the body lose every power and faculty; but Avicenna is invoked on this issue, and all those who maintain that every faculty flows from the heart. So at this juncture their own particular inborn powers reside in the [bodily] parts, as they do in the heart too, but they lack a main power to spur them on. Still, if that vital strength is long absent and does not flow in, as happens when an abrupt unwonted syncope carries someone off, I would not care to deny that in the end the faculties of the

tandem corruere et intercidere, animálque prorsus vitam dimittere: tanta quippe est vitalis necessitas, vt citra illius fauorem reliquae ne minimum quidem efficiant. Hinc rectè vitalis nomen ei potius quàm stirpium facultati est impositum, quòd praestantiore magisque salutari vitae genere corpora collustret, vnáque reliquarum omnium perseuerantiam et firmitatem contineat. Est enim animantium vita facultatum actionúmque omnium conservatio. Haec autem à corde cum spiritu caloréque defluit. Mors est vitalis roboris omniumque facultatum extinctio. Quas autem horum definitiones prompsit Aristoteles, eas non modò ad animantes, verùm etiam ad stirpes accommodauit, vt longè latéque paterent. Vis porrò ista vitalis, totius animae pars non est, quòd solitaria nusquam subsistat, quòdque illius ope nihil seorsum viuat: [PII2] sed totius est animae summa quaedam facultas, quae partes animae perficit, tuetur, et quasi nexu coniungit.

De facultatum concentu et principatus ordine. Cap. XVII.

TRES ANIMAE facultates quanquam in perfecto animante substantia, instrumentis, et sede seiunctae sunt, fieri tamen non potest, vt posteaquam in vno eodémque corpore coierunt, tum inde quasi diuulsae et seiugatae prorsus distrahantur. Mutua enim conspiratione vsque eo omnes inter se aptae et connexae sunt, vt vnaquaelibet reliquarum ope consistat. At verò fieri potest vt cuiuspiam particulae, vna animalis facultas pereat aliis commorantibus: aut simul cum animali naturalis etiam pariter occumbat, vna superstite vitali: quemadmodum fit dum in particulam per arterias dimanat vis spiritúsque vitalis, à cerebro autem et iocinere nihil quicquam illabitur. Tametsi igitur dum vita est, semper nutriri animal verum est et compertum, non tamen id in particulis fieri est necessarium. Vna vitalis caeteras perficit atque conuertit, et ab eisdem mutuis iuuatur officiis. Naturalis enim pabulum ei suggerit, animalis autem pectus pulmonésque agitans, tum alimenti tum refrigerationis eius est effectrix. Animali porrò reliquae duae materiam subiiciunt: naturalem autem vitalis per arterias illapsa tuetur atque auget, quae ipsa animali perpetuò eget. Ex quibus intelligitur indissolubili eas concentu teneri, nullam posse citra aliarum opem consistere, et vnaqualibet intercidente reliquas etiam pariter emori. Caeterùm quoniam variae et disiectae sunt earum sedes, quarum incommodum spiritus, tum calor, et facultatum substantia offenditur, fieri quidem poterit vt vnaquaelibet offensiunculam accipiat, aliis nondum laesis: quanuis ea si diutius inhaereat, in caeteras tum demum irrepit, fiátque

parts collapse and cease to exist, and the animal actually dies; the vital faculty is so essential that without its endorsement the others do not even operate at all. Hence it is right that the name “vital” is given to this faculty rather than to the plant one, because it embellishes bodies with a more excellent and wholesome kind of life, and is the one that sustains the stable persistence of all the rest; the life of animals is the preservation of all the faculties and actions. Along with spirit and heat, it flows out from the heart. Death is the annihilation of the vital strength and of all the faculties. The definitions of these that Aristotle set forth he applied not just to animals but to plants as well, so that they covered a very extensive field. Besides, that vital power is not part of the whole soul, since it does not exist anywhere on its own, and because nothing owes a separate life to it; but it is a crucial faculty of the [P112] whole soul, perfecting its parts, guarding them, and bonding them together.

Chapter 17. The harmony of the faculties and their precedence.

IN A perfect animal there are three faculties of the soul distinct in substance, instruments, and seat; nevertheless, once they have assembled in one and the same body, it is not possible for them to be, so to speak, wrenched from it and torn altogether apart; they are all so closely linked together in mutual concord that each depends on the rest. But it is in fact possible for the animal faculty of some part to perish on its own, the rest staying on; or for a natural faculty also to pass away in step with an animal one, leaving just a vital one; as occurs when vital power and spirit percolates along the arteries into a part, but nothing at all glides in from the brain and liver. Yet, so long as life is present, it is in fact a true finding that the animal is always being nourished, but this does not have to happen in the parts. The vital faculty is the only one that brings the others to completeness, and is assisted by them in their shared tasks. The natural faculty supplies it with food, and by keeping the chest and lungs in movement the animal faculty brings about its nutriment and cooling. Moreover, the other two furnish the animal one with material: the vital one glides in through the arteries to guard and build up the natural one, while itself always in need of the animal one. Hence it follows that they are maintained in an indestructible harmony; none can exist without the others to help it, and when any one of them ceases to exist, the rest die too with it. However, their seats are diverse and separate, and harm to these interferes with spirit, with heat, and with the substance of the faculties. In consequence, it will be possible for any one of them to suffer some small interference but the rest be still intact. Still, if the interference stays implanted longer, it will go on to worm its way into the others and become

omnium communis. Hoc autem intercidunt ordine, vt ab ea quae in malum et perniciem primùm incurrit, ea proximè laboret quae maiorem, postremò autem ea quae cum illa minorem necessitudinem aut cognationem habet. Ab animali enim primùm vitalis, deinde naturalis afficitur: à vitali animalis vt cui illa materiam et vitae formam ministrat, tandem verò naturalis: à naturali vitalis, mox animalis. Hunc ordinem tum ratio, tum rerum euentus edocuit, quoties pars vnica princeps simplici morbo tenetur. Quòd si vnaquaelibet facultas iacturam facere potest aliis nondum offensis, necesse est perurgente causa, eandem prius aliis, neque eodem omnes puncto temporis interire, licet exiguo pòst tempore vnus sit omnium interitus. Is itaque ex mutuo consensu affectionum ordo statuitur: caeterùm in actione et administratione corporis, alius multò diuersus. Exortu quidem prima est altrix, deinde vitalis, postrema animalis. Nobilitate et principatu prima atque praestantissima est animalis, ab hac vitalis, tertia altrix ignobilis et abiecta, haec enim vilium stirpium communis est: vitalis data animantibus, quia altricis actiones integrat et absoluit, ea praestantior vtique videtur, obscurior verò et inferior animal, vt cuius causa maximè condita sit: finis autem in quem reliqua contendunt, splendore et commendatione clarus est. Quinetiam animales functiones, sentire, moueri, ratiocinari, contemplari, sapienter viuere, quia altioris gradus et dignitatis sunt quàm solùm ac simpliciter viuere, planè declarant vim harum effectricem omnium summa esse et principatum tenere. In actionum autem et vitae necessitate omnium prima vitalis statuitur, quòd non modò reliquis materiam sufficiat, sed illas etiam suscitet, perficiat, mutuóque complexu tueatur et foueat. Siue enim particula quaeuis et motum et sensum habitura est, siue debet nutritionis commoda percipere, in eam necesse est spiritus et vis influat vitalis, quae si laedetur mox vtriusque functio interpellabitur, quasi in vtriusque opus communiter concurrat. Huius itaque beneficio quum reliquae indigeant, non autem è diuerso, vna omnium iudicabitur maximè ad vsum vitae necessaria.

Simplicem esse animam quae his partibus continetur, hincque Aristotelicorum rationes dissolui. Cap. XVIII.

[PII3] STIRPIBUS EA moderatur anima quam naturalem altricémque dixerunt, vt quae eius duntaxat gratia et officio vita fruuntur. Beluae

common to them all. They perish in the sequence that, when one of them starts the lapse into trouble and damage, it makes the next to suffer the one that has the closer bond or affinity with it, and the last the one that has the looser bond. For the animal faculty influences the vital one first and the natural one presently; the vital one influences the animal one first, being its supplier of material and the form of life, and the natural one at the end; and the natural one the vital one first and then the animal one. This sequence was the lesson of theory, and of the way things turn out whenever a single main part is occupied by a straightforward ["simplex"] disease. But if any faculty you please can bring disaster to others not yet involved, it must be extremely important that it should perish before the others, and that all should not perish at the same moment, even though they may do so soon after. And so this sequence of effects is made by their mutual harmony. But in relation to action and the operation of the body, there is another quite different one. At their emergence the first one is the nourishing one, the second the vital, and last is the animal one. In importance and supremacy the first and most excellent is the animal; next the vital; and third the nourishing one, base and mean, being common to the humble plants. The vital one assigned to the animals is the one that inevitably appears more excellent, because it brings to completion the actions of the nourishing one, and the animal one appears dimmer and meaner, having been made especially for its benefit; the target at which the others aim is in brilliant esteem. Again, the animal functions (sensation, movement, reasoning, reflection, the intelligent conduct of life) are of higher status and worth than life on its own and simple, and thus clearly indicate that the power that brings them about is the highest of all and preeminent. For the demands of actions and of life, the vital faculty stands in the first place of all, because it not only provides material for the rest, but awakens them, completes them, and nurtures and protects them in a shared embrace. If any part is to possess both movement and sensation, or ought to reap the advantages of nutrition, then the vital spirit and power must flow into it, but if they³¹ are damaged, soon the function of both will be interrupted, as if it³² is cooperating jointly for the task of each. And so, when the rest stand in need of its contribution, though not vice versa, it alone of them all will be judged the most essential for the purpose of life.

Chapter 18. The soul in these parts is simple, and hence the arguments of the Aristotelians break down.

[PII3] PLANTS ARE controlled by what people call the natural and nourishing soul, as it is only by its willing service that they have the benefit of life. Beasts

eam ipsam quidem, atque insuper alteram sentientem sunt adeptae. Ex his autem vitalis facultatis interposito aptè coniugatis, vna fit totius anima, cui pars illa praestantior nomen dedit. In homine omnes hae partes insunt, quibus tertia insuper accedit, mens appellata, tanta profectò familiaritate cum illis consentiens, vt ex omnium concentu vna euadat anima, quae intelligentiae et rationis est particeps. Caeterùm haec non ex illis tanquam ex discretis seiunctisque partibus condita est, quoniam vna simplex totius est forma, omnis expers coagmentationis et structurae, verùm nascitur ex illis quemadmodum posteriores Geometricae figurae ex prioribus. Trigonus enim ad alterum trigonum si decenter aptetur, fiet tetragonus, non composita quidem verùm simplex figura: ad hunc deinde accedens accommodatúsque alius trigonus pentagonum efficit, re ipsa quidem simplicem, at potestate compositum. Sic propemodum dum foetus vtero fingitur et conformatur, primum naturalis anima emergit séque prodit, deinde vitalis facultatis interuentu et conciliatione, anima sentiens comparet et elucet. Haec verò quanquam simplex est, vt in beluis, comitem tamen retinet vim illam naturalem, quae tum manens anima dici non potest, ne corporis vnus et eiusdem aut reuera complures formas, aut vnā compositam fateri cogamur. Inest tum igitur ceu illius pars duntaxat et quaedam facultas, quemadmodum quae in osse, aut quae in carne est forma quum iam totius species appulerit, supererit quidem non re ipsa et energia, sed tanquam praeparatio et facultas ministra formae succedentis: quod plenius alio loco disputauimus. Postremo autem quum mens consilij rationisque particeps immigrabit, quae sentiens fuerat anima, iam non reapse commorabitur et residebit, sed vt facultas quaedam et superioris illius quasi praeparatio. Hoc loco dubitatione et rerum obscuritate aestuant quidam philosophi, qui putant fieri non posse vt simplex nostra sit anima. Etenim mens intelligentiāque nostra sempiterna habetur et immortalis, quae extrinsecus nobis accessit: sentiens autem anima mortalis et caduca, quasi ex corpore procreata. Illa quasi separata et simplex, corpori non permiscetur, sed ei duntaxat vt naui gubernator assistit: haec verò in corpus penitus immergitur, à quo nunquam diiungi diuellique potest. Illa denique, vt cogitet, vt contempletur, et intelligat corporis subsidio non indiget: haec verò nihil efficere potest citra idoneam corporis eiusque organici praeparationem, cuius certè perfectio quaedam est et absolutio. Harum igitur rationum animaduersione complectuntur et efficiunt fieri non posse, vt tam dispares diuersaeque naturae, communi societate in vnus eiusdémque simplicis substantiam coëant. Itaque siue Platonis

have acquired this one, and besides a further one, the sentient one. Out of these two, closely linked by the interposition of the vital faculty, a single soul is made of the whole, with a name contributed by its principal part. All these parts are present in man, and a third too, called mind, assuredly in such friendly agreement with them that from the overall concord a single soul emerges, with a share of intelligence and reason. But it is not created from them as if from separate distinct parts, since the whole has one simple form, showing no seam nor structure, but sprung from them as the later figures of geometry spring from the earlier ones: if a triangle is fitted appropriately to a second triangle, there will be a quadrilateral, not a compound shape but a simple one; then a further triangle suitably added makes a pentagon, a thing simple in fact but compound in potentiality. This is virtually how, during the shaping and molding of the fetus in the womb, first of all the natural soul emerges and presents itself, and then the sentient soul manifests itself, by the mediation of the vital faculty. Although it is simple, as in beasts, it still keeps in its company that familiar natural power, which being still present cannot be called a soul, to prevent our being compelled to accept that one and the same body has either really several forms, or one compound one. There is present, then, so to speak, just a part and a faculty of it, in the way that the form ["forma"] in bone or in flesh, when set in motion by the form ["species"] of the whole, will not persist in reality and actuality, but as a preparation and a faculty in the service of the successor form. We have discussed this more fully elsewhere. Finally, when mind with a share of judgment and reason enters in, what had been the sentient soul will not now really extend its stay, except as a faculty and as a kind of preparation for its superior.

At this point some philosophers toss about on a sea of doubt and obscurity, and suppose that our soul cannot possibly be simple. And indeed our mind and intelligence, which reached us from outside, are regarded as eternal and immortal: but the sentient soul is mortal and transitory, as if begotten from the body. Mind is, so to speak, separate and simple, not mingling with the body, but just supervising it as the steersman supervises his ship. Sentient soul is completely immersed in the body, and can never be torn away from it. In fine, mind needs no help from the body to think, ponder, and understand; but sentient soul can achieve nothing without appropriate preparation of the body and its range of instruments, of which it is surely the perfection and completion. By attention to these arguments, people sum up and deduce that it is impossible that such widely divergent natures should associate together and combine into the substance of one and the same simple thing. And so, whether Plato's view or

siue Aristotelis sententia recipitur, hoc vtroque impedimentum accidere contendunt, vt non simplex, sed ex diuersis partibus concreta sit anima. Sic igitur grauissimis hisce vexati implicatque rationibus haerent in salebra. Caeterum quisquis quae ad hanc controuersiam litemque minuendam attulimus, animo et cogitatione comprehendet, censebit animam quae in nobis est rationis et intelligentiae particeps, non ex aliis tanquam ex partibus componi, sed simplicem esse et tanquam reginam (quum accesserit) aliarum principatus obscurare, vt vna praestantissima dominetur, quae omnium vires atque facultates haud secus atque pentagonus, simplex illa comprehensas teneat. Quaecunque enim praestantior est et superior, supparis vires omnes habet. Hinc fit vt simplex ea et singularis, vna possit omnia in nobis vel dissimilima [*sic*] efficere, sed alia quidem per se, alia corporearum facultatum adminiculis. Vt enim soluta mens et libera cogitat, ratiocinatur, et meminit, sic talia efficit in nobis nullius corporis adiuta concretionem mortali. Illa corporis soluta vinculis omnia sentit, idque purè, dilucidè, et quale quidque sit: at verò his terrenis concretisque corporibus intersepta, non nisi quinque nuntiis externa cognoscit. Eadem naturae vtens facultatibus corpus vniuersum alit, vtens vitalibus hominis vitam sustinet. [PII4] Haec igitur omnibus fons est et principium mouendi, quod à se non ab alio quoquam mouetur. Qua potissimum ratione planè cognosci potest, animam immortali conditione sustineri: hinc etiam quòd infinitam rerum innumerabilium cognitionem capit, memoriàmque retinet, quòd res occultas ab omni sensu et corpore seiunctas inuestigat, quòd tot res et tantas nullius concreti corporis subsidio efficit. Quae enim his est ornata viribus, nequaquam concreta esse potest ex terrena mortalique natura, nihil admistum, nihil concretum, nihil coagmentatum capit. Itaque simplex quum sit, nec secerni, nec diuidi, nec discerpi, nec distrahi potest. Nec interire igitur. Ex quo demum intelligitur omni illam turbido motu semper vacare, nec dolore nec aegritudine pulsari. At multa è corpore existunt quae illius functiones iuuent et acuant, multa quae obtundant et impedian. Corpore acri et vehementi quadam status conuersione confracto, illa confestim emigrare cogitur. Quae mala quum adsunt, quid causae est cur illa functiones suas non implet? An propriae substantiae iacturam quandam fecit? At ea nec offendi nec labefactari potest. Instrumentum illius violatum est? At nullum ei concedimus. Quid igitur restat?

Aristotle's is accepted, they maintain that the difficulty arising in both cases is the soul not being simple, but composed of various parts. Harassed and entangled in this way in these very weighty arguments, they are stuck in a rut. However, anyone whose mind grasps the contribution we have made to the abatement of this dispute will conclude that the soul, sharing in the reason and intelligence within us, is not composed of other souls forming, so to speak, parts of it, but is simple, and resembles a queen after her accession, in outshining the supremacy of others, so that she alone rules with outstanding distinction, she being the simple lady [*"simplex illa"*] to hold the powers and faculties of all, just as a pentagon does; anything of more elevated excellence possesses the whole range of nearly identical powers. This is how it comes about that this one simple unique entity can carry out everything in us, even very different things, but some of them on its own and others with the help of bodily faculties. The independent free mind thinks, reasons, and remembers; it does such things in us in this way without the aid of the mortal composite of any body, and untrammelled by bodily constraints it senses everything, making out with pure clarity what sort it is and what it is; in contrast, when cut off by these earthy and composite bodies, it recognizes the outside world only by the five messengers. And by the use of the natural faculties it nourishes the whole of the body; by using the vital faculties it supports human life.

[P114] This, therefore, is for everything the wellspring and basis of movement, being moved by itself but not by anything else. From this argument particularly it can be clearly recognized that the soul is of immortal status; from the reason too that it acquires unlimited knowledge of innumerable things, retaining the memory of them; that it inquires into hidden things detached from every sense and from the body; and that its achievements are so numerous and so extensive, done without the aid of any composite body. Anything endowed with these powers cannot possibly be composed of earthy and mortal nature, and includes no admixture, nothing composite, nothing assembled. And so, being simple, it cannot be separated or divided or pulled apart; and so cannot die. It follows in the end from this that it is always free of violent agitation, and of the blows of pain and sickness.

But many things arise from the body to aid and sharpen its functions, many also to blunt and block them. It is compelled to move out at once when the body is broken down by some savage violent change of state. When these evils arrive, what is the reason that it does not carry out its functions? Has it jettisoned some of its own substance? But this cannot be injured or weakened. Has its instrument been damaged? But we do not allow it any. So what is left?

Corpus quod proprium illius est domicilium praepediri. Vt enim opifex idoneis instrumentis instructus, si in tenebricosum aut arctum conclaue contrudatur, nequit quae artis suae sunt efficere, sic anima vitioso corpore, quod est tanquam domicilium, coërcita, quae sua sunt munia exequi non potest. Conuenienti enim corporis mediocritate teneri desiderat, quae si parum commutabitur, functionibus illa suis interpellabitur: sin multum, tantam illam discrepantiam perhorrescens nec ferre potis, de corpore decedit.

De moralibus facultatibus. Cap. XIX.

IN EST AUTEM in homine aliud earum facultatum genus, in quibus mores versari proditum est à virtutum magistris. Est id quidem genus vniuersum appetens, quod nimirum in totidem differentias distrahitur, quot animae facultates sunt locis sedibúsque seiugatae. Siquidem suprà enucleatè disputatum demonstratúmque est, vnamquaque non nisi proprio appetitu ad agendum impelli. Itaque vt animae ita appetitionis pars altera rationis est particeps, altera huius experts. Has enim inter se distare atque seiungi puerorum mores demonstrant, qui iracundia aestuant rationis nondum compotes. Quinetiam adulti qui prudentia praediti sunt, multorum plerunque importuna cupiditate flagrant, quae insurgens ratio et obsistens dissuadere ac peruertere conatur: hincque frequenter acerrima pugna committitur, planè ostendens non vnicam, sed duas saltem esse facultates, vnam rationi obtemperantem, alteram voluptatum amicam. Quum autem ratio certamine fortassis euicta fuerit, qui ita vitiorum blanditiis et voluptatibus succumbit, iratus deinde seipsum obiurgat: túmque rationi assistens iracundia tanquam auxiliaria, partes eius tutatur, cupiditatis ardores et impetus oppugnatura. Ex quibus intelligi potest non modò duas, sed tres in nobis facultates morales inesse. Rationis particeps appetitio, voluntas nuncupata, constanter prudentérque quippiam desiderat: quae verò huius est experts, partibus duabus tenetur, quae sunt cupiditas et θύμωσις,⁴ illa in iecore, haec in corde. Cupiditatis rursum partes sunt libido et cupedia, illa in testes, haec in ventriculum effusa. Appetendi autem facultates iis quas dixi sedibus diiungi, ex propriis earum perturbationibus clarum erit et perspicuum, quae sunt huiusmodi. Libidinis perturbatio aut aegritudo est mulierositas, contraria autem offensio eius atque fastidium, μισογυνεία id est odium mulierum. At cupedia perturbationes et aegrotationes habet, circa cibum quidem liguritionem, circa vinum temulentiam: offensiones autem, cibi et vini fastidium, et stuporem,

The body, its special abode, is being hindered. Like a workman with the right tools but pushed into an ill-lit or cramped room, where he cannot do his proper work, the soul is not able to perform its tasks when shut up in a faulty body, which serves as its residence; it needs to occupy a body of a suitable intermediate level, and if the level changes a little, the soul will be interrupted in its functions; if the level changes much, in dread of the intolerably large deviation, it departs from the body.

Chapter 19. The moral faculties.

ANOTHER KIND of these faculties is present in man, faculties in which, according to the tradition of teachers of the virtues, standards of conduct are involved. This is the whole appetitive kind, evidently divided into as many different sorts as there are faculties of the soul separated by their locations and seats. For there is a precise argument and proof above that each of them requires its own appetite to stimulate it into action. And so, as is the case with the soul, appetite has one part with a share of reason and the other without any. That these differ from each other and are separate is seen from the conduct of children, who seethe with rage before they have attained to reason. Further, adults who possess prudence are often ablaze with perverse violent desire for many things, things that reason rises to block, and to try to discourage and divert. Violent battle is often joined at this point, and shows clearly that not one but at least two faculties exist, one of them obedient to reason, the other the sweetheart of pleasures. And when reason has perhaps been worsted in the battle, the man who thus gives in to the enticing attractions of vices goes on to reproach himself furiously; and then indignation, standing shoulder to shoulder with reason, protects its parts, and is off to attack the heated onslaughts of violent desire. Hence it can be seen that in us there are not just two, but three moral faculties. The appetite that has a share of reason, the one called will, seeks anything with steady foresight; but the appetite without this share comprises two parts, which are violent desire (in the liver) and passion (in the heart). Then again, the parts of violent desire are lust and gluttony, the former distributed to the testicles,³³ the latter to the stomach. That the appetitive faculties are separated into the seats I mentioned will be evident from the disorders peculiar to them, which are as follows. The disorder or disease of lust is excessive fondness for women, and the repulsion that is its opposite is misogyny, or hatred of women. Gluttony has disorders and diseases: gourmandism in relation to food, drunkenness in relation to wine; and has repulsions: distaste for food and wine, and insensitivity,

quo qui tenetur suauitatem cibi non sentit. Vtriusque autem mediocritas est temperantia. Vis animi in corde inhaerens, vt in variam materiam quam vtilem iudicat, nec tamen obtinet (his enim causis duabus incitatur, priuatione et vtilitate) appetitione sua fertur et incumbit, ita variis perturbationibus conquassatur. Huius est ambitio, quae gloriam persequitur et honores: auaritia quae pecuniam et opes auet: ira quae iniuriam punire et vindicare cupit: metus qui futuri mali opinione conturbat. Quum verò iam bonis potitur, gaudio et laetitia animus exultat: sin mala inciderunt, doloribus affligitur. [P115] Iam verò si quas partes corporis singulae perturbationes exagitant, diligenter animaduertimus, constabit opinor quo quaeque in loco facultas insideat atque inhaereat. Par est enim vnamquamque facultatem in ea potissimum parte tanquam in sede constitui, quae illius perturbatione euidentius impelli et conquassari deprehenditur. Atqui dum iracundia, doloribus, gaudio, metu, caeterisque huius ordinis perturbationibus concutimur, conspicuè et insigniter cor in nobis aut opprimi aut gestire percipitur. Qui vehementer esuriens aut sitiens inedia consumitur, huic tristi quodam languore praecordia contrahuntur, qui mox lenitur mitiòrque sit, vt cibi potúsque quippiam demissum fuerit. Quinetiam vterum gerentes alienorum sordidorúmque, vt luti, vt carbonum extraordinaria appetentia lacessitae, mox absoluuntur atque liberantur, si qua potione ventriculum ac iecur expurgent. In delirio, obliuione, et stultitia, vt summus ille splendor rationis extinctus est, ita et cerebrum grauiter afficitur, huicque non autem cordi adhibita praesidia, ex vsu sunt et salutaria. Haec quum in aperto sint et cuique obuia, nihil iam ambigi debet appetitionem eam quae compos est rationis, in cerebro tanquam in arce propriáque sede collocari: eam verò quae ad iram procliuis est et θύμωσις dicitur, in corde, quod vnum inter omnia viscera maximo ardet incendio, vt hos possit impetus inflammare: postremam autem quae cupiditas appellatur, subter praecordia maximè vero in iecore considerare. Posteriores duae quia variis vt dixi perturbationibus agitantur, patibiles quidem sunt et affectioni subditae: atqui si patibiles, mortales etiam sunt et caducae: necessum enim est affectionum diuturnitate contabescant. At verò prima quae rationi obtemperat, vt nullis perturbationum fluctibus iactatur, nullisque vitiorum procellis obruitur, ita prorsus impatibilis et immortalis censi debet. Hinc percipi potest hanc istam appetendi vim, incorpoream esse mentis supremae conditione:⁵ reliquas autem tum corpori immersas, tum nobis esse cum beluis communes. Quanquam autem illa cum caeteris intelligentiae facultatibus, vna eadémque mentis substantia tenetur, non tamen cum illis confunditur, sed diligenter

which prevents its victim from appreciating the attraction of food. The mid-point of each is temperance. The power of the mind ["animus"], which dwells in the heart, is influenced by its appetite, presses toward varied material that it judges advantageous but does not possess (urged on by two causes: lack and advantage), and so is disturbed by various upheavals. To this power belongs ambition, seeking glory and honors; avarice, desiring money and resources; anger, wishing to avenge an injury; fear, with distressing expectation of a bleak future. When it already controls possessions, the mind rejoices in happy satisfaction; when misfortune has struck, it is smitten with distress.

[P115] If now we carefully examine the parts of the body that are unsettled by individual disturbances, I believe that the location of each faculty's seat will be agreed. It is reasonable that each faculty should reside particularly in the part that turns out to be more obviously the target of its disturbance. What is more, when we are being smitten by rage, pain, joy, fear, and the other disturbances of the sort, it is the heart that is noticeably oppressed or exultant in us. A starving person who is reduced by hunger or thirst has his rib cage squeezed by a miserable weakness, which is presently assuaged when some food or drink has been swallowed down. Further, pregnant women who are tormented by abnormal appetite for strange and filthy things like mud or charcoal are promptly released if they purify stomach and liver with some drink. In delirium, loss of memory and stupidity, the high brilliance of reason is put out, and the brain too is seriously impaired; remedies applied to it rather than to the heart are customary and of value. This being public and obvious to anyone, there should not now be doubt that the appetite that shares in reason is located in the brain as its citadel and particular seat; but the one that inclines to anger and is called passion is located in the heart, the one organ that blazes with the greatest fire of them all, so that it can ignite these impulses; the last one, called violent desire, resides below the precordia, especially in the liver. Since these latter two are, as I said, upset by various disturbances, they are capable of being acted upon, and exposed to the result ["affectioni"]. And if they are thus capable, they are mortal and transitory, and must decay if the results are prolonged. But the first [of the appetites, evidently] is obedient to reason, and not being tossed about by billows of upheaval nor storms of disorders, must be considered beyond being acted upon, and immortal. From this it can be seen that this power of appetite is the incorporeal state of the highest mind; but the other ones are both embedded in the body and common to us and the beasts. Although, along with the rest of the faculties of the understanding, it occupies one and the same substance of the mind, it is not confused with them; the basis of each faculty should be carefully

facultatis cuiusque ratio discernenda. Sic quam in corde constituimus vim excandescantiae, cauendum prouidendúmque est ne cum vitali, tanquam vna sint, confundamus: nam tametsi eadem sunt sede eadémque substantia comprehensae, diuersas tamen facultates esse, effectuum operúmque varietas renuntiat. Ita propemodum in iecore posita cupiditas, ab eiusdem altrice vi quamplurimum differt, licet vnus sint substantiae. Vbique enim appetens facultas prior est suis comitibus, quas quasi admotus stimulus ad agendum incitat et impellit. Haec de animae facultatibus quae primò sese offerebant, iam pari verborum contractu, earum functiones proximus liber decurrat.

LIBRI QUINTI DE ANIMAE FACULTATIBUS FINIS.

distinguished. So we must take care not to confound the power of flaring rage, which we locate in the heart, with the vital power, as if they were one; for even though they are held in the same seat and the same substance, the diversity of their effects and achievements proclaims that their faculties differ. So violent desire, virtually sited in the liver, differs very greatly from the liver's nourishing power, though they are of one substance; for everywhere the appetitive faculty is prior to its companions, which it urges and, as it were, goads to action. These are the matters that first presented themselves about the faculties of the soul; let the next book now run through their functions, with similar terseness.



DE FUNCTIONIBUS ET HUMORIBUS. LIB. VI.

Alimenti in ventriculo confectio. Cap. I.

FACULTATIBUS COGNATIONE tanta functiones cohaerent, tàmque immutabili continuatione iunguntur, vt aliarum ex aliis cognitio capi debeat, fuerítque necesse nobis pariter de ambabus superiorem sermonem facere, qui vtrarumque omnes ex aequo differentias recenseret. Quamobrem de functionibus dum hoc loco rursum dicere instituo, neque profectò enitor vt illas nobis adesse demonstrem: neque vt earum differentias enumerem, quippe quas omnes iam suprà plenè cumulatèque sumus complexi. Verùm à facultatibus tan-[PII6] quam à causis conuersione facta, articulatim distinctèque edisserere contendo, qua lege, quo ordine vsae suis illae spiritibus, suisque particulis et temperamentis, tanquam instrumentis functiones omneis suas compleant, vt simul inde partium omnium corporis humani commoditates et vsus in promptu sint et eluceant. Primùm autem omnes sigillatim scrutabimur et explicabimus in homine iam genito omnibúsque suis partibus absoluto, deinde in eo qui gignitur in lucémque profertur: atque in illo quidem naturae primùm, deinde animae, postremò vitae functiones attingemus. Summum supremúmque naturae munus est nutritio, quam ex alimento accepto illa perficit: hoc enim illius est tota materia, in quam penitus incumbit, quam variè tractans expurgat, conuertit, propriis ductibus in omnes extremásque corporis particulas diffundit atque confert. Quodcunque durius et solidius est alimentum, dentibus in ore constructis manditur, extenuatur, et molitur, nec leuem inibi conuersionem accipit, admiscétque sibi quodammodo animantis qualitates, vt pristinam speciem et naturam vix retineat. Quod sanè potissimum efficit tum diligens confractio atque confectio, tum pituitae oris perfusio, quae ad alia quoque plurima non modicas facultates obtinet, tum oris calor, tum denique tunicae eius, quae ipsi quoque ventriculo continuata est et communis, attrectatio. Mansum iam et ad nutritionem praeparatum alimentum, crebra agitatione et motibus



BOOK 6

THE FUNCTIONS AND HUMORS

Chapter 1. Preparation of food in the stomach.

THE FUNCTIONS are such close kin to the faculties, and linked to them in such unchangeable interconnection, that acquaintance with either should be gained from the other, and it will prove necessary for us to apply to each alike the previous discussion, as it reviewed impartially all the distinguishing points of both. Consequently, as I start once more to speak here about the functions, I am certainly not striving to show that they are present in us, nor to enumerate their distinguishing points, since we have taken all these fully and abundantly on board already. But having turned away from faculties [PII6] as causes, I am striving to expound point by point the guiding principle and sequence on which they make use of their spirits, parts, and temperaments as instruments to discharge all their functions, so that at the same time the advantages and uses of all parts of the human body come to be in full and clear view. We shall look at and reveal them all one by one, first in the human being already begotten and complete in all its parts, and secondly in the same coming to birth and emerging into the light. In the former, we will outline the functions of nature first, of the soul next, and of life last. The crowning and supreme task of nature is nutrition, which it carries out from the food ingested, food which is the whole material for nutrition. Nutrition applies itself intimately to the food, handles it in various ways to purify it, alters it, and distributes it through special channels into every part of the body, however distant. Any food that is rather hard and solid is chewed, whittled down and ground up by the teeth set in the mouth, and undergoes significant conversion there, mixing into itself in a way the qualities of a living thing, so that it barely retains its original form and nature. This is obviously particularly the work of thorough breakdown and preparation, then of oral moistening by phlegm (which possesses numerous major faculties in other directions), then of the mouth's heat, and finally of contact with its lining, which runs on to be shared with the stomach too. Once chewed and prepared for nutrition, the food is propelled by repeated stirring movements of the

linguae detruditur, ídque excipit stomachus [no punctuation here, or in 1542 or 1554] via communis per quam illabitur in ventriculum. Est autem hic et cibi et potionis receptaculum: omniáque rectis in interiore tunica positis fibrís à gula detrahit, atque eisdem gula ab ore prolectat, perinde ac si dicas ventriculum per gulam quasi per manum ab ore cibos eripere. Haec porrò actio à transuersis villis, qui in externa sunt gulae tunica adiuuari videtur. Cùm enim quippiam siue aridum siue humidum ab ore depellimus, transuersae fibrae quae infra idipsum sunt dilatantur, quae autem supra, contrahuntur, ídque adeò arcè vt inter deuorandum plerunque haustus spiritus, tametsi tenuis est, simul impulsus et adactus remigrare vix possit. Itaque partim ventriculo trahente, partim detrudente gula, ciborum fit depulsio. Ventriculi attractionem incitat appetentia, et iis qui extra modum appetunt promptior celeriorque fit depulsio: cùm enim fames immodica dominatur, venter cibos nondum in ore planè confectos, mandentibus etiamnum et inuitis plerunque eripit, vt fame latrantem se obsonet.¹ Quae sibi adduxit sinu suo complexúque recipit: eadem continendi facultate et obliquarum fibrarum ministerio includit, complectitur, continet suprà subtérque et omni ex parte adeò compressè, vt his circumiici et prorsus adhaerescere videatur, nec inane quicquam relinquat, si quidem conuenienter et secundum naturam se habet. Alioqui cibus in tanta capacitate huc illuc fluitans, neque lateribus ventriculi coarctatus haudquaquam plenè concoqui posset. Tum igitur pylorum interclusum ac prorsus obsignatum reperire est, vt non modò arceat crassiorem cibum, sed nec liquidum ac maximè profluentem elabi sinat. Ea profectò ratione concludit cohibétque accepta, nec ante legitimum naturaeque praescriptum tempus effluere quicquam patitur, nisi cùm aut magno copiae pondere, aut qualitatis mordentis acrimonia lacescit. Est autem id legitimum tempus, quo plenam perfectámque concoctionem absoluit. Hoc interim spatium facultas concoquens, cibum omnem mutat et conficit, nullis quidem fibrarum adminiculis, sed tum proprio ingenitóque calore et spiritu, tum eo quem vt lebeti magno circumiectus ignis, ita et proximae partes illi inferunt, iecur, lienis, cor, diaphragma, vena caua, et omentum, quod illius calorem coërcet duntaxat atque continet. Caeterùm propria ventriculi substantia concoctionis illius absolutionem perficit, ídque non modò vulgatis et notis illis qualitibus, verùm etiam tacita et recondita proprietate. Itaque his omnibus tanquam ministris adiutus ventriculus primùm quidem alimenta in vnum cogit, et alia cum aliis, arida cum humidis confundit, simul verò omnia frangit et exterendo comminuit, vt iam partes omnes

tongue, and received by the gullet, the common path along which it slips into the stomach, the store for both food and drink. The stomach pulls everything down from the gullet by the longitudinal ["rectis"] fibers of its internal lining, the same that the gullet uses to coax the contents out of the mouth, as if one were to say that the stomach seized food from the mouth with the gullet as its hand. Further, this performance appears to be assisted by the transverse fibers that lie in the external lining of the gullet. When we propel something, be it dry or moist, down from the mouth, the transverse fibers below it are extended, while those above it are contracted, and so tightly that as a rule breath taken in during swallowing, rarefied though it is, can hardly move back, being pushed on its way at the same time.¹ And so the downward propulsion of food goes on partly by the stomach's pull and partly by the gullet's push. Appetite stimulates gastric pull, and in people of immoderate appetite the propulsion gets prompter and faster; under the control of excessive hunger, the stomach often seizes food before it is fully prepared in the mouth, while people are still chewing and reluctant to swallow, victualing itself like a creature howling with hunger. It receives into its interior what it has drawn in, embracing it through the same retaining faculty and the aid of the oblique fibers, and squeezing it above and below and on every side so tightly as to look like a completely adherent surround. No empty space is left, if the stomach is in an appropriate and natural state. If this were not so, the food would swirl to and fro in such a large interior, and not being held in by the sides of the stomach, could not reach complete concoction. Accordingly, at this time the pylorus is to be found closed and completely sealed up, not just to stop the thicker food, but not to let even liquid free-flowing food slip out. It is undoubtedly in this fashion that it confines its contents, and allows nothing to escape before the proper time laid down by nature, unless harassed either by the great weight of the load or by the ferocity of a stinging quality. The proper time is when it has reached a complete concoction. In the interval the concocting faculty changes and prepares all the food, without assistance from the fibers [of the stomach coat], by its own innate heat and spirit, and by the heat that, like a fire set around a great cooking pot, is contributed by the adjacent parts, the liver, spleen, heart, diaphragm, vena cava, and the omentum, which just holds its heat in. Moreover, the particular substance of the stomach brings this concoction to completion, and not only by those generally known qualities, but also by a secret and hidden property. And so, with the aid of all these, so to speak, assistants, the stomach starts by gathering the foods together, and mingles one with another, the dry with the moist; at the same time it fragments and crushes up everything, so that all the

quandam substantiae aequabilitatem adeptae videri possint. Quae dum ita exquisitè permiscentur, necessariò quum ex misionis lege, tum ex affectionis natura mitigantur, et deposita omnia qualitatum exuperantia in quendam mediocritatis ordinem adducuntur et recidunt, fitque vnus-[P117] modi eiusdémque naturae substantia, speciem quandam cremoris consequuta. Hoc primum est concoquentis facultatis opus, ciborum in cremorem conuersio, quam et ventriculi et vicinarum partium solo calore fieri credibile est. At verò id concoctio nondum censi debet, quòd talem ars sola plerunque nobis exhibeat, sed duntaxat praeparatio quaedam ad concoctionem. Posthaec verò cremor hic aptam et accommodatam nutriendo animali qualitatem atque substantiam sumit tùmque perfectè mutatur et conficitur: eaque mutatio et in chylum facta conuersio, concoctio ea est quam definimus. Fit autem haec non modò vi et ardore caloris, sed etiam tota ventriculi substantia, et insita quam diximus proprietate. Sic struthiocamelus ferrum coquit et exerit, quod non leo calidissimus, sed ne ignis quidem ardor effecerit; sic fruges aridas et praeduras minutae aues conficiunt, omnesque crudum quippiam subigunt et mutant, quod vix audeat homo attingere; sic coturnix veratrum coquit et mitigat, nobis prorsus inimicum, inuictum, indomitum, et quod omnem corporis nostri vim, omnes conatus respuit et aspernatur. Quodcunque autem idoneum et conueniens alimentum ventriculus acceperit, id demum vincit atque mutat, omnesque in id tum qualitates, tum naturae suae vires confert. Hoc iam plenè coctum tametsi ingratum gustatui videtur, potestate tamen et viribus conueniens est et salutare. Idipsum autem concoctio est, nempe in peculiarem et propriam eius quod alitur qualitatem conuersio. Aristoteli quidem haec ἔψησις² existit, id est (vt iuniorum nomine vtar) elixatio: est enim in humido facta coctio. Quidam ex veteribus hanc falsò corruptioni annumerant, idcirco alimenta temporis spatio in ventriculo commutata putrescere existimantes, quòd pristinam saporis odorisque gratiam non seruent, sed prorsus iniucunda, graui molestoque tum sapore, tum odore sensus feriant. At illi parum cognitum habent eam concoctionis salubritatem, non gustatu, non olfactu, sed virium praestantia et substantiae familiaritate ponderandam esset et aestimandam. Eius porrò quod iam conuenientem et familiarem qualitatem est adeptum, portionem quandam sibi arripit ventriculus: nam quod in cremore longè optimum est et congruens, id halitus specie ad se rapit, ínque suas tunicas sugendo recondit, eis etiam adiungit et agglutinat: ex quo demum fructum voluptatémque percipit, et quodammodo saturatur. Veram hanc esse nutritionem à Galeno quidem videtur proditum literis: quod tamen nonnulli de interiore ipsius duntaxat

portions can be seen to have taken on some uniformity of substance. While they are being thoroughly mixed in this way, they are inevitably softened, both by the conditions of the mixing and by the nature of the interaction [“affectio”], and give up anything outstanding in the qualities, being brought into a sort of middle range. The substance becomes of one and the [P117] same kind and nature, reaching some likeness to cream. This is the first achievement of the concocting faculty, converting foods into cream, which probably occurs simply through the heat of the stomach and nearby parts.

But this should not be regarded yet as concoction, since technical skill on its own often shows us a similar process; it is just a prelude to concoction. Later on, this cream takes on a quality and substance suited to nourishment of a living creature, and its alteration is then completely accomplished; this alteration and the conversion into chyle is the concoction of our definition. It comes about not just by the heat’s power, but also by the whole substance of the stomach, and the property inside which we mentioned. Thus the ostrich digests and erodes iron, a feat beyond not only the hottest lion but also fire’s heat. Thus tiny birds digest dry rock-hard seeds, and they all knead and alter anything raw, which a man would hardly dare to attempt. Thus the quail digests and softens hellebore, to us totally refractory, defying and despising all the power and efforts of our body. But the stomach ends by overcoming and changing all appropriate food that it has received, and contributes to it all the qualities and powers of its nature. This fully digested product may seem unpleasant to taste, but in its potentiality and powers is appropriate and healthy. This is what concoction is: conversion into the particular quality of the recipient of the nourishment. To Aristotle this is “hepsesis,” or, to use the word of the younger men, “elixation”; it is coction carried out in moisture. Some of the ancients reckon it wrongly with putrefaction, supposing on that account that foods altered in the stomach over a period of time decay, since they do not retain their original attractive savor and odor, but turn entirely unpleasant, impinging on the senses with a nasty oppressive taste and smell. They have not sufficiently recognized that the healthiness of concoction is to be assessed by the excellence of powers and the close association of substance, not by taste nor by smell. Further, the stomach seizes for itself a part of what has already acquired an appropriate and familiar quality; what there is in the cream that is far the best and well-suited, the stomach appropriates in the form of a vapor, and hides it away by sucking it into its coats, attaching it to them. It is from this that it reaps [“percipit”] profit and pleasure, and in a way is satisfied. Galen appears to have handed down in writing that this is true nutrition. But some people interpret it as referring just to the

tunica accipiendum interpretantur, hancque ex tenuiore benignioréque chyli vapore sustineri: externam verò ex sanguine alimentum capere per venas conspicuas ex iocinere in se pertinentes atque directas. Ego verò vt hanc sic et interiorem illam sanguine nutriré duco, neque pastionem eam quam ex chylo ventriculus capessit veram nutritionem appello, sed ex qualitatis cognatione et conuenientia oblectationem quandam et satietatem nutritionis aemulam. Exanguia (fateor) non pauca animantia, vt conchae, vt vermes succo aluntur, qui veram sanguinis speciem non accipit: at non protinus existimandum est idipsum in sanguineis obtingere, quòd nihil quicquam praeter sanguinem possit in eorum substantiam conuerti. Quocirca fieri non potest vt chylus proximum sit ventriculi alimentum. Quae quidem mea assertio, ne inanis esse videatur, illa me causa mouet, quòd dum foetus vtero continetur, totus ventriculus maximéque interior eius tunica, puro ac syncero sanguine alebatur, nullo nimirum tum vsquam existente chylo. Nunc igitur quia cumulatiús atque perfectius is ali postulat, optima ratione similiter ex sanguine nutritur et incrementum suum capesset. Quinetiam ossa quae longiore interuallo quàm ventriculus à sanguinis natura recedunt, sanguine ali fatemur: quanto magis igitur ventriculi membranae sanguinem pro suae naturae custodia requirent? Quí fit igitur, inquires, vt cibis ventriculo conceptus, famem et appetentiam sedet atque saturet, si is neque ventriculum pascit neque nutrit? Fames quidem et animalis appetentia totius est ventriculi, praesertimque oris eius, tum temporis potissimum excitata, quum supra modum exinanita ventriculi capacitate, eius latera collapsa, in sese concidunt conuelluntque grauiter vicina sibi praecordia, et quum interiores recessus et quasi rugae proprio humore exhausto inaruerunt. Hoc interim spatium ventriculus tum se suamque capacita-[P118] tem implere et quasi farcire, tum verò succi vtilioris quippiam in interiores illos recessus recondere desiderat. Vtroque autem desiderio eum laborare argumento est, quòd modico cibo qui interiorem duntaxat tunicam oblinat, saturari non solet, nisi ipsa etiam interior capacitas expleatur: quòd etiam dominante fame, dum quis cibum capit, non protinus vt hic intrò demissus est, sed aliquanto post satiatur desiderium, quum perutilem succum ventriculus in tunicam rapiens summa cum voluptate amplexatur, sibi que apponit perinde ac si eo verè aleretur. At certè ea nequaquam propria est nutritio: sed succus ille vacua tunicae spatia referciens, in vaporem fusus et extenuatus ad extremum vanescit: isque sua potius qualitate quàm substantia famem depellit.

stomach's internal coat, a coat they regard as maintained from a more rarefied and kind vapor of chyle; on the other hand, the outer coat receives nutriment from the blood through prominent veins running from the liver in its direction. For my part, I hold that both coats alike are nourished by blood; I do not refer to the feeding from chyle in which the stomach engages as true nutrition, but as a sort of delight derived from the affinity of quality, and a satiety that mimics nutrition. There are, I accept, not a few bloodless animals, such as worms and shellfish, that are nourished by juice that does not possess the true form of blood. But it must not be directly supposed that the same applies to animals with blood, because nothing but blood can be converted into their substance. Consequently it is impossible that chyle should be the immediate nutriment of the stomach. In case this claim of mine should seem unfounded, the reason that influences me is that during intrauterine life, the whole of the stomach, and particularly its internal coat, was being nourished by pure uncontaminated blood, with of course no chyle anywhere at the time. Consequently, as it now demands more abundant and complete nutriment, it will be nourished and engage in growth on the best basis from blood, in a similar fashion. Furthermore, we are agreed that bones, which are further removed than the stomach from the nature of blood, are nourished by blood; so how much more will the membranes of the stomach need blood for the protection of their nature?

"Then how does it come about," you will say, "that food held in the stomach assuages and satisfies hunger and appetite, if it neither feeds nor nourishes the stomach?" Hunger and animal appetite are features of the whole stomach, and especially of its mouth, and are particularly stimulated at the time when the interior of the stomach is exceptionally empty; its sides fall in on each other and seriously dislodge the nearby rib cage, and the recesses and (so to speak) wrinkles inside have dried up through exhaustion of the particular humor. In the meantime the stomach requires to [P118] fill and, so to speak, stuff itself and its cavity, and also to replace some more useful juice in those internal recesses. The facts indicate that it is burdened by both requirements, because it cannot usually be satisfied by modest food that lines just the internal coat, unless the internal cavity itself is filled up too; and also because, with hunger in control, during the eating of a meal the desire is not satisfied the moment the food has gone down inside, but a little later, when the stomach seizes very useful juice into its coat, welcomes it with great joy, and applies it to itself as if it were really being nourished by it. Yet this is certainly not its proper nutriment; the juice filling up the empty spaces of the coat disperses and thins into a vapor, and vanishes completely. It dispels hunger more by its quality than by its substance.

Famem dico animalem appetentiam: naturalem quippe vna duntaxat sanguinis substantia per ventriculi corpus et molem effusa, satiare potest, dum in eius naturam conuertitur: caeterùm animalem non modò sanguis, sed et quicquid qualitatis cuiusdam suauitate praeditum in ventrem demittitur, compescit.

*Vt è ventriculo per intestina et venas mesaraicas in iecur fiat
alimenti distributio. Cap. II.*

POSTEAQUAM PERFECTÈ planèque cibos ventriculus concoxit, iisque abundè saturatus est, os infernum cui pyloro nomen est diducit, aspernatúrque quicquid alimenti reliquum est, tanquam redundans ac molestum. Quamobrem tum otiosa et feriata continendi facultate, officiorum vsa vicissitudine expultrix exurgit, quae transuersas fibras contrahens, ventriculum coangustat: atque iam confectum chylum à se excludit, detrudítque per pyloron in intestina. Caeterùm quum sit ventriculus in naturalium instrumentorum numero, cautio etiam atque etiam adhibenda est, ne imprudentes hunc tanquam animal ratione intelligentiáque praeditum producamus, quòd prouidentia quadam et cura aliarum etiam partium saluti consulat. Non enim eò cibos concoxit, vt reliquis partibus alendis eos accommodaret, sed dum sinu complexúque eos continet et vndique comprehendit, propriae saluti atque voluptati dans operam, necessariò eos commutat. Vnde et idonea cibi portione iam expletus, quod reliquum est tanquam onus inutile à se deponit exigitque, non quòd in reliquas partes conferre quicquam conetur, in ídque viribus incumbat. Itaque dum sibi prouidet, et in eo maximè est occupatus, aliis etiam vtilitatem et fructum affert, non quidem ex instituto, sed fortuitò tanquam aliud quippiam agens. Hac igitur via et ratione geruntur omnes ventriculi functiones, si modò integer est et incorrupta sanitate, nec quorundam iniuriis lacessitur, quae vel magno copiae pondere, vel qualitatis acrimonia stimulent. Quae sanè [*sic*] quemadmodum et quaecunque posthac tradentur functiones, tum ex quotidianis naturae operibus, tum ex viuorum atque mortuorum consectione comprobari solent. Quod ergo in ventriculo redundat alimentum, in intestina protruditur: exceptum autem (neque enim id trahunt, neque huius gratia fibras rectas habent intestina) confestim praeteruehitur, à depellendi facultate, quae in intestinis inest longè valentissima, ad cuius muneris functionem vtraque tunica fibras obtinuit transuersas et in orbem actas. Quoniam autem

I call hunger the animal appetite; the natural one can be sated only by the single substance of blood, dispersed throughout the body and bulk of the stomach, and in process of being converted into its nature. On the other hand, the animal appetite is allayed not only by blood, but also by any of some quality that possesses pleasantness and is sent down into the stomach.

Chapter 2. The distribution of nutriment takes place from the stomach by way of the intestines and mesenteric veins into the liver.

WHEN THE stomach has completed the concoction of foods and is amply satisfied with them, it dilates the lower opening called the pylorus and expels all the remaining nourishment, as superfluous and burdensome. Consequently, with the retaining faculty idle and out of use at the time, there is a change of tasks: the expulsive faculty comes into action, and by contracting the transverse fibers narrows the stomach; the stomach drives out the chyle that is now digested, and discharges it through the pylorus into the intestines.

But since the stomach is one of the natural instruments, caution must be more and more urgently exercised so that we do not rashly regard it as an animal endowed with reason and intelligence, as it cares for the health of other parts too with a kind of attentive foresight. It did not carry out concoction of foods to adapt them for the nourishment of the rest of the parts, but it has to alter them in the interest of its own health and delight, while retaining them in its embrace and entirely surrounding them. And now, filled up from there with an appropriate share of food, it unloads and expels what is over, as a useless burden, not in an attempt to contribute anything to the rest of the parts and apply its powers to that. And so, looking after its own interest with closest attention, it benefits the other parts too, not deliberately, but accidentally as though with some other aim. This, then, is the way and principle by which all the stomach's functions are carried on, provided its health is unimpaired, and it is not vexed by damage from things that sting it either by the great weight of their bulk or the bitterness of their quality. These functions, just like any that will be discussed later, are usually confirmed both by the daily achievements of nature and by dissection of the living and the dead. Consequently excess nutriment in the stomach is ejected into the intestines, and when received (the intestines do not draw it in, nor possess longitudinal fibers for this purpose) is passed on without delay by the propelling faculty, far the most powerful one in the intestines; for its functioning each coat has acquired transverse and circumferential fibers. But since the

multiplex est intestinorum anfractus et flexuosa circuitio, haud ita facile alimentum perlabitur. In tanta igitur viae longitudine, defluentis materiae quicquid coctum est et salutare, potest opportunè in iecur per mesenterij venas transportari. Vix enim fieri potest, vt in tam longo viae tractu vlla succi portio praeterfluat, quae non ad cuiuspiam venae os aliquando sese applicet, et quae si primum fortè ambitum praeterlapsa erit, secundo vel tertio, vel alio deinceps consequente non arripiatur, suctaque apprehendatur. Quod autem hunc anfractum praetergreditur, nec raptum fuerit in mesenterij venas, tanquam inutile et superuacaneum in crassiora intestina deiicitur, quò simulac peruenerit excrementi appellationem sumit: honestiori nec inquinato verbo cibi reliquias appellant. Hae tum astringentibus se intestinis, tum relaxantibus tandem in aluum depelluntur, in quo tanquam in receptaculo resident dum propulsentur foras. Alui extremum podex est, quem σφιγτήρ musculus ambiens atque circumfundens marsupij modo [P119] intercludit, nec quicquam antè elabi sinit quàm ratio iubet. Dum autem arbitratus imperio hic relaxatus soluitur, naturaliter quidem expellentibus intestinis, nonnunquam verò adiuuantibus diaphragmate et abdomine, excrementa deturbantur. Ex quo planè intelligi potest deiectionem hanc prorsum naturalem esse, retentionem verò voluntariam, quae solius sphincteris opera completur. Quanquam autem non prius è ventriculo cibus delabitur, quàm plena et absoluta concoctione sit mutatus, in ipso tamen per intestina transitu elaborationem etiamnum et absolutionem completam adipiscitur, quòd iners et otiosa nunquam esse possit, quae in eis est commutandi facultas. Simul verò eo transitu atque prolapsione, vtile quippiam et conueniens intestina sugunt, sibique apponunt, quo demum (perinde vt de ventriculo antè commemoratum est) perfruuntur. Caeterùm vera eorum nutritio per venas fit mesenterij, quae sanguinem è iocinere reuehunt, quemadmodum eadem vicissim chylum comportant. Vt enim arboris tenuissimae radices è terra succum trahunt, ita quae in quoduis intestinum pertinent venarum ora, quantum chyli coctum est, et à reliquo cibo secretum, id omne hauriunt et exorbent: ab hisque venis minoribus ad maiores permanat, dum tandem ad iecoris portas se applicet: ad hanc quippe regionem aditus est et introitus per multiplices admodum vias, easque perangustas. Praeparant hae quidem chylum iecori, conferuntque quasi rudimentum sanguinis, quale in eis per consectiones deprehendi solet, idcirco sanè quòd à iecore initium ducunt, cuius proinde naturam referunt et aemulantur. Si arteriae quae ad intestina feruntur ac pertinent, nonnihil etiam humoris è cibo alliciunt, id omnino perexiguum esse debet, quòd crassior illic succus existat, sintque arteriae spiritui halituque trahendo accommodatae. Qui vnum sensum aestimatorem iudicèmq̃ adhibuerit, mesenterij venas

intestines follow a winding course with many twists, the nutriment does not readily pass along. So, during such a long path, the concocted and healthy part of the material flowing by can be opportunely conveyed into the liver by the mesenteric veins; it is barely possible that during so long a passage any part of the juice should run past without attaching itself sometime to the mouth of some vein, and being caught up and seized by suction at the second or third or some later vein, even if it has happened to get by at the first pass. What gets through this curve without being snatched into the mesenteric veins is evacuated into the larger intestines, as useless and superfluous, and as soon as it arrives there it acquires the name "excrement"; a more respectable and less debased term is "residue of the food." Contraction and relaxation of the intestines drives this ultimately into the rectum, which serves to contain it until it is expelled to the outside. The end of the rectum is the anus, which a sphincter muscle girdles and [P119] shuts off like a purse, allowing nothing to slip out before reason gives the order. When it is relaxed on the instruction of the will ["arbitratus"], excrement is dislodged, the intestines expelling it naturally, sometimes with the assistance of the diaphragm and abdomen. Hence it can readily be seen that the expulsion is entirely natural, but retention is voluntary, being brought about by the action of the sphincter alone. And although food does not slip out of the stomach until altered by complete concoction, yet it still reaches ultimate perfection during passage through the intestines, since the altering faculty in them can never be idle and at leisure. During this sliding passage, the intestines suck up and attach to themselves something useful and appropriate, and it is of this that in time they have the enjoyment, just as was described earlier about the stomach. But their real nutrition occurs through the mesenteric veins, which carry blood back out of the liver just as they convey chyle [to it] in turn. Just as the slenderest roots of a tree draw juice out of the earth, so do the venous mouths belonging to any intestine swallow up all the chyle that has been digested and been separated from the rest of the food. It percolates from these lesser veins to larger ones, until in the end it nears the gates of the liver. The approach and entry to this region is through quite complex paths, very narrow paths too. They make the chyle ready for the liver, and contribute a kind of initial stage of the blood, such as is often found in them during dissections; no doubt this is because they trace their origin to the liver and reproduce its nature accordingly. If the arteries that run to the intestines and belong to them do in fact attract some humor out of the food, it must be very little at all, because the juice there is quite thick, and the arteries are suited to the drawing in of spirit and breath. Anyone who has made use of the senses alone as umpire will maintain that the mesenteric veins are designated for

ventriculi et intestinorum nutritioni, non autem succorum distributioni
 destinatas esse contendet, quòd omnes semper rubro, nunquam albo succo
 confertae videntur: quòdque in ventriculi et intestinorum substantiam se figant,
 neque ad interiorem capacitatem apertae sint. Veruntamen quoniam aliae nus-
 quam viae ex intestinis in iecur directae feruntur, per quas alimentum influat,
 ratio magis quàm sensus conuincit eas etiam ad distributionem accommodari.
 Existet autem mox quaestio non parùm difficilis atque ardua, multùm et saepe
 quaesita, per singulàsne mesenterij venas tum nutritio, tum distributio sit: an
 potius aliae ad nutritionem, aliae ad distributionem aptae sint et constitutae.
 Omnes vna sanè et communi conditione seruitutis vtuntur, nec vlla operae
 varietas illas seiunxit: sed singulis vtrunque datum est, tum vt in iecur chylum
 transportent, tum vt ex hoc in intestina sanguinem refundant: neque id quidem
 temporum et officiorum quadam vicissitudine, sed simul vna eadèmq̃ue hu-
 morum congressione. Quanquam autem eisdem venis permiscetur chylus
 atque sanguis, trahentium tamen partium naturae et desideria causae sunt, quòd
 diuersae diuersa prolectent atque secernant, quemadmodum in alui purga-
 tionibus, non obscurè fieriprehendimus. Ad haec verò sciendum probè est,
 superiores venas quae in ventriculum et gracilia intestina concedunt, minus sanè
 quàm inferiores humoribus è venis et ex iecore purgandis destinari. Nam in
 dysenteria multòque apertius in tenasmo, mordax et acris humor in crassiora
 intestina illabitur, quo tempore plerunque superiora nihil noxae et incommodi
 ferunt, sed cocta alimenta continent atque distribuunt, tametsi aluus inferior
 continenter prouocata humorem deiicit. Dum alimentis nonnihil purgantis
 facultatis permiscebitur, vno eodèmq̃ue temporis momento nutritio fiet et in-
 festi humoris secretio: hic per venas inferiores in aluum detrudetur exigiturque
 foras, alimentum verò per venas superiores in iecur raptum concedet. Ad hunc
 igitur modum alimentum in iecur perlabitur, trahentibus quidem tum mesen-
 terij venis, tum verò iecore per venas. Rapiunt autem id maximè ob conuenien-
 tis cuiusdam facultatis communionem, veruntamen aliae permultae sunt causae
 quae transuectioni celeritatem addant, vasorum amplitudo, succi tenuitas cum
 permeandi impetu, et attrahentis facultatis robur. Ex qualitatis quidem cognat-
 ione, vinum quàm aqua ocysus in corpus assumitur: at substantiae tenuitas et vis
 quaedam penetrandi, causa est vt vinum album [P120] promptiùs quam rubrum
 et austerum in iecur peruadat, id enim expeditiùs trahentis vim consequitur. Si
 distributio, exposita modò ratione, trahendo duntaxat perficitur, quomodo
 mente concipiemus corporis habitum eiùsque venas

the nutrition of the stomach and intestines, but not for the distribution of juices, because they always appear full of red juice and never of white; also, they bond themselves into the substance of the stomach and intestines, and are not open to the cavity inside. However, since no alternative paths to carry in nutriment run anywhere from the intestines into the liver, reason rather than the senses persuades [us] that they are suited for distribution too.

A question of considerable difficulty will emerge next, one vigorously and frequently pursued: do both nutrition and distribution occur through individual mesenteric veins? Or is it rather that some are adapted and established for nutrition and others for distribution? They all certainly follow a single common role of servitude, and are not distinguished by any difference of effort; but each of them has both tasks, to convey chyle into the liver, and to let blood flow back out of it into the intestines. This is not through an alternation of times and tasks, but through one and the same synchronous encounter of humors. Although chyle and blood are mingled in the same veins, the natures and needs of the parts drawing them along are the causes that make different parts attract and separate off different things, as we notice manifestly happening in purgings of the bowel. What brings this satisfactorily to notice is that the upper veins, which make for the stomach and small intestines, are clearly intended less for the purging of humors from the veins and liver than the lower veins are: in dysentery, and much more obviously in tenesmus, a corrosive and bitter humor slips into the larger intestines, at a time when the upper intestines mostly convey nothing harmful or inappropriate, but contain and distribute digested nutriment, even though the lower bowel is under continuous challenge and evacuates humor. Some of the purging faculty will mingle with the nutriments, and at one and the same moment nutrition and secretion of harmful humor will take place: the humor will be squeezed down through the lower veins into the rectum and expelled, but the nutriment will be grasped and taken into the liver by the upper veins. So in this manner the nutriment will slip into the liver, drawn both by the mesenteric veins and by the liver along the veins. They carry it off especially because of association with some appropriate faculty, but numerous other causes contribute speed to the transfer: the width of the vessels, the thinness of the juice along with the effort of penetration, and the strength of the attracting faculty. On account of the affinity of quality, wine is taken up into the body faster than water; on the other hand, thinness of substance and a sort of penetrating force is why white wine permeates into the liver [P120] more rapidly than dry red wine, being quicker to follow the power drawing it. Now that its basis has been explained, if distribution is performed just by drawing along, how shall we conceive the physique of the body and its veins being

extra modum impleri, quod in illo habitu atletico vsuuenire compertum est et proditum. Nulla siquidem tum partibus abundè saturatis inest appetentia, quae trahendi desiderium iniiciat aut stimulet. Si igitur non appetunt, neque profectò alimentum rapient. Deinde pars vnaquaeque idcirco alimentum trahit, vt eo perfruatur: quod si iam plenè fruitur, non est quod noui desiderio pulsetur, nec quod ad id trahendum sese comparet. Veritatem porrò huius rei impura eorum intemperantia illustrabit, qui tanquam gurgites et voragines de poculorum magnitudine certant et bibendo se superant. Quanquam enim multas vini amphoras exorbent et exiccant, quae tamen ab illis depelluntur cibi reliquiae, nihilo fiunt liquidiores: argumentum sanè quicquid vini absorbuerunt in venas id omnino permanasse. Quinetiam si tenue ac potens vinum fuerit ingestum, et qui ad iecur patent aditus soluti fuerint, nec obstructio distributioni moram et impedimentum vsquam afferat, quale ferè haustum fuerat vixque vlla ex parte commutatum profundi cernetur. Quod si aliquispiam omnem huiusmodi distributionem trahenti facultati attribuit, nec vinum quantumuis tenue existimat nisi tractum in venas peruadere, edoceat is quaeso et planum faciat, qua ratione complura medicamenta angustas admodum vias, venásque praetenuas subeant, et nullam non corporis partem peragrent. Non liceat ad trahendi facultatem confugere eámque molestè obtrudere, cui nihil híc loci relictum est. Nulla enim medicamentis cum corporis partibus affinitas intercedit, imò contrà odio penitus insito, tacitisque discordiis plurimum inter se dissident, naturae prorsus infensa. Quamobrem his non excitabitur vis appetendi, nec demum illius impulsu trahendi facultas insurget, quae illa tam aduersa in venas et corpus alliciat. Caeterùm quum illa quoquouersum permeantia, omnia traicere et peruadere medicorum curationes multis iam seculis comprobarent: quaenam obsecro huius alia potest causa probabilis afferri, quàm quòd illa aut substantiae tenuitate, aut alia quapiam vi ingenita sibi, in corporis interiora penetrent? Hoc si est, quid quaeso obstabit quo minus multa etiam alimenta praetenui substantia aliisque facultatibus valeant, quibus velut impulsa promptiùs ferantur ac permanent in corpus? Quum quis ad mediocritatem et ad satietatem se impleuit, omnémque cupiditatem tum ventris, tum reliquarum partium saturasse creditur, si crudus postridie se rursus ingurgitet, an non potius humor in venas se protrudet, quàm partium vi prolectetur? Si hae satietatem expleuerunt, cur pluribus et immodicis humorum ponderibus sese obruent? At (inquiunt) ventris ori ingenita vis est appetendi,

overfilled, as is known to happen in the well-known athletic physique? For in parts that are fully saturated at the time, there is no appetite to instil or provoke a need for drawing in. If then they have no appetite, they will assuredly grasp no nutriment. Next, every part draws in nutriment in order to get the enjoyment of it; if it has this to the full already, it has no cause to be stimulated by a desire for something new, nor to gather itself to draw it in.

Further, the truth of this matter will be displayed by the unsavory intemperance of those who vie with each other over the size of their potations, like besotted drunkards,² and outdo each other in drinking. They drain many wine jars dry, yet the food residues they deposit become no more liquid: clear evidence that the wine they have swallowed has entirely percolated into the veins. Again, if the wine ingested has been thin and potent, the entrances to the liver have been wide open, and no obstruction anywhere delays or blocks distribution, the character of what has been swallowed will be recognized, and that it has hardly poured out from any part in an altered form. But anyone who ascribes all this sort of distribution to the faculty of drawing in, and supposes that no wine, however thin, permeates into the veins unless drawn in, should oblige by teaching and making clear the basis on which a number of medicaments traverse quite narrow paths, and very slender veins, and penetrate every part of the body. Resort to the faculty of drawing in, and its aggressive introduction, may not be permitted; there is no room left for it here. No affinity exists between medicaments and the bodily parts; rather the opposite, they disagree fundamentally with each other, with a deeply ingrained hatred and unvoiced disharmony: things totally harmful to nature.³ Consequently the power of appetite will not be evoked by them, nor finally will its onset arouse the faculty of drawing in, to entice these so hostile things into the veins and the body.

But medical cures over many past ages have demonstrated that these medicaments make their way to all parts and permeate them; what credible cause can be alleged for this, pray, except that they penetrate into the inside of the body, through the thinness of their substance or through some other power inherent in them? This being so, what will there be, tell me, to prevent many nutrients too being enabled by their thin substance and other faculties to be conveyed quite speedily into the body, as if pushed in, and to stay there? When someone has filled himself to the midpoint and to satiety, and is held to have met every desire of both stomach and the rest of the body, then if before his digestion is done he stuffs himself⁴ again next day, surely the humor will propel itself into the veins, rather than being lured in by the power of the parts? If the parts have reached complete satiety, why will they overwhelm themselves with further and excessive weights of humors? "But," they say, "there is a power of appetite

quae cum sensu quodam eximio indigentiae atque plenitudinis molestiam percipiat, saturari quidem potest: reliquae autem partes eo sentiendi munere destitutae sunt, quae quoniam satietate nulla premuntur, naturali quodam desiderio tanquam stirpes, ex venis nullo puncto temporis intermisso alimentum rapiunt, neque fieri potest si materia suppetit, ut aliquando illae trahendi finem faciant. Haec mihi videntur delicatior ut ita dicam molliorque ratio, quam philosophi vis gravitatisque postulat. Si enim partes assidue trahunt, insaturabiliter explentur, estque naturalis earum cupiditas insatiabilis. Hoc verò quid aliud est quam partes perpetuo et insanabili malo teneri? quam morbum cum integra valetudine confundere atque omnia perturbare? Bulimum quidem et diabetem affectiones praeter naturam dicimus, quod assiduo desiderio ad trahendum impellant, neque ullum agendi modum adhibeant. Similiter igitur et in nobis quantumvis bene valentibus, si partes corporis trahendi moderationem non adhibent, debent infirma atque etiam aegra valetudine censerī. Iam verò quod illi proponunt partes corporis [read "corporis" with 1542] nullum sensum habere indigentiae atque plenitudinis, quem exitum reperire possit aestimemus. Hoc fixum atque ratum omnes habent, venas et habitum corporis cum supra modum implentur, plenitudinis mole veluti pondere aliquo grauari: hinc grauissima mala impendere, quae prospiciens Hippocrates iubet habitum soluere sine mora. Hoc et natura saepe aggreditur, dum onere oppressa et quasi extincta, miris conati-[P121] bus superuacuum molem per nares, per vterum, aut mariscas à se tanquam à ceruicibus depellit. Deinde verò multis ante rationibus corroboratum est, partibus naturalem quendam sensum inesse conuenientis et aduersae qualitatis, eoque naturale desiderium incitari. Quod si est, cur non item molesti ponderis atque gravitatis sensus inerit? Iam si quis inest ut certè videtur, cum ad mediocritatem partes implebuntur, earum cupiditas et naturale desiderium expleri satiarique debet. Quocirca si supra hanc mediocritatem eas impleri contingat, non id solum trahentis facultatis desiderio, sed iis maximè causis quas supra recensui, fieri necessum est.

Sanguinis et humorum in iecore procreatio. Cap. III.

EX INTESTINIS autem et ventriculo secretus à reliquo cibo succus is quo alimur, permanat ad iecur per quasdam illinc vsque ad πύλας, id est portas iecoris ductas et directas vias. Sic enim appellant venam in iecoris introitu peramplam, ad quam tenues mesenterij venae pertinent. Huc totus chylus confectus iam coctusque perlabitur, qui tamen mox rursum dispersus in omne iecur distrahitur. Quas enim venas ad portas natura in vnam

inborn in the mouth of the stomach,⁵ which can be satisfied when by an exceptional sense of lack and of fullness it detects distress.⁶ The rest of the parts are devoid of this sensory function; under pressure not from any feeling of satiety, but from a natural need like plants, they grasp nutriment from the veins, never missing a moment, and if the supply holds out, never stop drawing it in.” This seems to me too easygoing, if I may say so, and complacent an argument for the requirements of a philosopher’s authority. For if the parts continually draw in, they are filled up insatiably, and their natural violent desire is beyond satisfaction. How does this differ from being in the grip of an endless incurable evil? Or from mixing up a disease with sound health, and unsettling everything? We say that bulimia and diabetes are preternatural conditions, because they incite an endless need to draw in, and do not introduce any limit to the action. It is the same with us too, however well we are: if the bodily parts do not apply control, their health must be judged precarious and even sickly.

Now this view of theirs, that the parts of the body have no sense of lack and fullness: let us reckon what outcome it can find. Everyone takes it as permanently established that when the veins and physique are overfilled, they are burdened by the bulk filling them as though by a weight; very serious evils then loom; Hippocrates with his foresight recommended that the physique should unload them without delay.⁷ Nature sets about this too often, and when heavily laden and virtually dead, makes extraordinary [P121] attempts to expel its excessive load through the nose, the uterus or the hemorrhoids, in the same way as from necks.⁸ It was confirmed later by numerous arguments that a natural sense of the appropriate and opposite quality resides in the parts, by which natural desire is excited. If this is so, why will there not be a sense of burdensome weight and heaviness too? If there is one, as there certainly seems to be, then the violent desire and natural need of the parts should be allayed when they are filled to the midpoint. Hence, if they happen to get filled beyond this midpoint, this must occur not just from the requirement of the faculty of drawing in, but especially from the causes that I reviewed above.

Chapter 3. Production of blood and humors in the liver.

THIS JUICE from the rest of the food, by which we are nourished, is extracted out of the intestines and stomach, and percolates from there along certain paths leading straight up to the liver’s gates [“portas”], a name given to the very wide vein at the liver’s entrance, towards which the thin mesenteric veins aim. To here all the chyle flows, now prepared and concocted, and next it is dispersed again throughout the whole liver; the veins that nature had linked into one at

coniunxerat, mox rursum in iecoris corpus disiecit, quae quum tenues et admodum angustae sint, non facile et celeriter potest succus distributionis impetu allatus per has peruadere. Quocircà is in iecore diu multúmque cunctatur, et in transitu haeret: éstque tarda eiusmodi transuectio loco retentionis et morae, quae absolutae concoctioni necessariò debetur. Quum igitur tanta sit venarum per iecur disiectarum exilitas, succus totus ad eius carnem propriámque substantiam proximè accedit, à qua vniuersus vsquequaque attingitur. Ob hanc verò moram diutinam, et ob exquisitam in iecore contagionem, chylo per minima quaeque distributo, tum celerior, tum integrior sanguinis asciscitur species, quàm si ampla capacitate, qualis est aut cordis aut ventriculi, conciperetur. Ad quod non parum confert quòd quae in iecore sunt venae, tenuibus admodum tunicis sunt praeditae. Quem igitur chylum ope venarum mesenterij praeparatum, et rudi quadam sanguinis forma adumbratum iecur accepit, hunc per eam moram et contagionem, vera et expressa sanguinis specie ornat et perficit: cuius operis non quaeuis illius sine delectu particula, sed quae duntaxat illius propria est caro atque substantia effectrix est, quanquam reliquae omnes in id vsum quendam et commoditatem habent. Dum ea caro quae substantia concretum et coactum sanguinem exprimit, allapsum ex ventre chylum sensim enititur in propriam naturam commutare, sibique prorsus assimilare (est enim hic scopus vnus in quem vnaquaeque particula caloris sui munus dirigit atque refert) primùm quidem crassiorem reddit et colore rubrum: quúmque iam ad quandam mediocritatem accessit, sanguis verè est et appellatur, tantò à iocineris substantia deficiens, quantò ventris chylum superat. Ex quo percipi potest sanguinis confectionem, non modò caloris beneficio, sed maximè iocineris ingenita proprietate compleri. Huius proportionem eorum quae in reliquis partibus gignuntur humorum, vt lactis, vt seminis concoctionem aestimari velim: vt non aliud sit concoctio, quàm imperfecta et inchoata quaedam assimilatio, seu gradus quidam et aditus ad assimilationem. Geniti iam sanguinis portionem quandam familiarem ac benignam sibi iecur adiungit, agglutinat, et assimilat, non vt ventriculus aut intestina chylum, sed nutritione perfecta illam in propriam naturam conuertens. Reliquam verò sanguinis partem ceu redundantem et sibi superuacaneam, in venam cauam perlabi sinit, à qua in totum corpus distribuitur per venas sanè quam multas, in omnes partes corporis pertinentes. Caeterùm priusquam hanc distributionem oratione persequamur, sanguinis procreatione paulò altius repetita, inuestigemus quínam et quales quótque humores vnà cum sanguine gigni solent. Mustum recens ab vuis expressum coniectúmque

the liver's gates she then split up again into the body of the liver. Since they are thin and quite narrow, the juice cannot pass easily and quickly through them, pulled along by the effort of distribution. Hence it is held up long and in bulk in the liver, and lingers in its passing. Transfer of this kind is slow, to provide the restraining delay that is essential for complete concoction.

The veins scattered throughout the liver are so very thin that all the juice closely approaches its flesh and particular substance, being all in contact with it on every side. Because of this prolonged stay, and the intimate contact in the liver, with the chyle very finely dispersed, a more swift and unimpaired form of blood is acquired than if it were contained in a wide cavity, such as the heart or stomach. A significant contribution to this comes from the fact that the veins in the liver possess quite thin coats. So the chyle taken up by the liver, prepared by the activity of the mesenteric veins and with a rough form of blood sketched in, is finally equipped there with the true and clear-cut form of blood, by this lingering contact. This task is not brought about by any part of the liver without discrimination, but just by its particular flesh and substance, although all the rest of the parts have some use and advantage for the purpose. The flesh, the substance that produces blood composed and concentrated, strives gradually to convert the chyle exuding from the stomach⁹ into its own nature, and to assimilate it completely; this is one purpose to which every small part applies the function of its heat. It starts this by making the chyle thicker, and red in color; and when it has attained some midpoint, it really is blood and is so named, falling as far short of hepatic substance as it is superior to gastric¹⁰ chyle. Hence it can be seen that the complete preparation of blood is not just due to heat, but especially to the innate property of the liver. I would like the concoction of the humors, such as milk and semen, that are generated in the remaining parts to be assessed on the analogy of blood, concoction being simply an uncompleted sort of assimilation, or a step on the way to it. The liver attaches to itself and assimilates a welcome and kindly portion of the blood now brought into being, not handling it as the stomach or the intestines handle chyle, but by complete nutrition altering it to its own nature. The rest of the blood, being superfluous for its needs, it allows to slip away into the vena cava, which distributes it into the whole body through what is certainly a very large number of veins, related to all parts of the body.

But before we pursue this distribution in our account, let us investigate the generation of the blood a little further, and inquire what humors are usually generated along with the blood, what their character is, and how many there are. We see that the innate heat of surplus freshly expressed grape juice, collected into

in dolia, cernimus ab innato sibi calore efferuescere, mutari, et concoqui: hinc superuacanea comparere quae prius quidem confusa inerant, ac tum primùm concoctionis vi secernuntur atque secedunt, alterum quidem grauius magisque terrenum, quod in fundo subsidens fecem appellant: alterum leuius magisque aëreum, quod per summa innatat et flos vini dici solet. Simili profectò ratione [P122] chylus in iecur transfusus, cùm humidus quidam liquor sit, quodammodo feruet et concoquitur, tandémque nonnihil crassum existit, feci respondens, nonnihil etiam tenue et leue flori consimile, hoc bilem flauam dicimus, illud melancholicum humorem. Haec quidem superuacanea, quia sunt ad corpus alendum minus idonea, idcirco sanguini puro corporis alimento permisceri non par erat. Quamobrem natura illa segregans, flauam bilem in propriam vesiculam ad iecoris portas constitutam, melancholiam verò in splenem confert et reponit. Itaque vesicula proprio ductu et via ex iecore bilem attrahit, eámque synceram, nec alio quoquam humore adulteratam, tum quòd viae angustia crassiorem illabi non sinit, tum quòd eiusmodi attractio maximè ex humoris familiaritate et occulta conuenientia incitetur. Quamquam enim mordax est et acris hic humor, vesiculae tamen proprióque receptaculo tristis non est aut infestus, sed mutua cognatione iucundus et amicus, ex quo illa voluptatem et iucunditatis sensum percipit. Caeterùm eo haudquaquam alitur, quòd vsquequaque amarus sit nullo benigno succo perfusus, sed sanguine quem suscipit per venam conspicuam ex portis iecoris in suum ipsius collum insertam. Cùm bilis copia supra modum turgescit, onere se leuat quod ab se in intestina exigit atque deponit, idque via altera quae magna ex parte in ieiunum intestinum contendit. Haec secretio tum intestina ad celerem reliquiarum deiectionem impellit, tum eas ipsas fuluo tingit colore. Lienis porrò parte concaua venam gerit à portis iecoris allatam, qua is à squalido illo et melancholico humore iecur expurgat. Hunc enim insita facultate, qua sibi gratus est et suauis attrahit et in se recondit, per venarum tenuitates diffundens: assidua deinde opera summáque administratione hunc elaborat, comminuit, exterit, et in tenuiorem quoad licet succum commutat, ad hanc quidem actionem tum robur innati caloris, tum perpetuam arteriarum (quae illic multae sunt et ingentes) pulsationem accommodans. Qui in splenem allicitur sanguis eum qui in iocinere continetur crassitudine superat: verùm cùm in illius venis et arteriis elaboratus fuerit, non vniuersus neque crassior illius portio, sed tenuior duntaxat lienis fit alimentum, et in eius carnem sensim illabitur. Id autem quamuis tenue sit, nequaquam tamen rubrum est, sed subnigrum

vats, makes it effervesce, be changed, and be digested. From this surplus items are forthcoming that were previously indistinctly present, and then get extracted and isolated for the first time by the power of concoction: one quite heavy and more earthy, which falls to the bottom and is called sediment; the other lighter and more airy, which floats on the top and is usually called the scum. It is assuredly in a similar manner that [P122] chyle traversing the liver, and being a moist liquid, boils after a fashion and is concocted, and in the end something thick appears, corresponding to sediment, and also something thin and light resembling scum; we call the latter yellow bile, and the former the melancholic humor. These surplus items are less suitable for nourishing the body, and consequently it was inappropriate to mix them with blood, the pure nutriment of the body. Nature therefore separates them, gathering and storing the yellow bile in its own bladder at the liver portals, and the melancholic humor in the spleen. And so the bladder attracts bile out of the liver by its own duct, in pure form, uncontaminated by any other humor, both because the narrow path allows nothing thicker to slip through, and because attraction of this sort is particularly evoked by the close association and hidden appropriateness of the humor. Corrosive and bitter though this humor is, it is neither unpleasant nor harmful to its own gallbladder, but agreeable and friendly in a mutual relationship, and the gallbladder acquires enjoyment and a pleasant feeling from it, but is not nourished by it (it being wholly bitter, through pervasion by no kindly juice), but by the blood that it takes up through the prominent vein implanted into its neck from the gates of the liver. When it is swelled excessively by abundance of bile, it relieves itself of the load it contains, depositing it into the intestines, and doing so by the other path, which is mostly directed into the jejunum.¹¹ This secretion both urges the intestines to purge leftovers quickly, and tints the leftovers themselves with a tawny color. Further, the spleen carries a vein on its concave part which stems from the hepatic portals, and along this it clears the liver of the notorious murky melancholic humor. It draws it in and stores it, diffusing it through slender veins, by the inherent faculty that makes the humor acceptable and attractive to it. Then with the utmost continuous application it works upon it, crushes it down, and converts it to thinner juice so far as possible, applying to the purpose both the strength of innate heat and the endless pulsation of the arteries, which here are numerous and vast. The blood that is attracted into the spleen outdoes in thickness the blood held in the liver; but when it has been processed in the splenic veins and arteries, it does not all become nutriment for the spleen, nor does its thicker part, but just the thinner one, and it slips gradually into its flesh. Although the flesh is rarefied, it is not in the least red, but blackish,

lienens colore: quemadmodum qui sanguis iecur alit crassus est et ruber: sic enim conueniebat vnumquodque familiari et cognato sibi humore nutriri. Crassior autem melancholici humoris portio quae lienis vi nec molliri nec subigi potuit, tanquam ad nutriendum inepta, in os ventriculi proprio ductu quasi eructando eiicitur. Haec quidem cum austera sit et acerba, ventriculum astringit et in angustum adducit, ut inde omnis illius actio firmior sit et validior. Deinde verò in ventris capacitatem relabitur: hinc vna cum alimentis in intestina excidit, tandem verò quia inutilis in cibi reliquiis inhaerens cum eis foras propulsatur: non enim denuò in venas et iecur illinc traducitur, ut neque flaua bilis quae iam dudum expulsa, alui superuacua infecit. Rursum autem vini comparatio ante oculos exponenda est, si pituitae ortum atque substantiam placet animo percipere. Quod bimestre adhuc est, quamuis à fecibus et spuma expurgatum, gustatu tamen subcrudum, austerum et astringensprehenditur, quòd crudis partibus visum effugientibus perfusum sit. Has dierum numero vini calor euincit et concoquit, indicio quod vinum annuum aut bimum [*sic*] qui degustabit, iam maturatum id, suaue, plenum caloris et roboris percipiet. Sic in sanguine à quo vtraque bilis secreta iam est, crudus quidam humor confusus permiscetur, cui perpurgando natura nullum instrumentum designauit, quòd segregari excludique non deberet. Est enim quasi dimidio coctum alimentum, quod manens cum sanguine vna rapitur in venas, ut per inedias et cibi penuriam tempore mutetur et integrè coquatur, fiatque sanguis commodus et salutaris. Haec pituita non quemadmodum dictus suprà melancholicus humor aut flaua bilis, superuacua censi debet, quum sit ad nutriendum apta: neque praeterea muco mananti è naribus, neque ei lentae crassaeque pituitae similis est quam in ventre et intestinis necessariò gigni perhibent. Haec enim ventriculi concoctione deficitur, ut ne succus quidem omnino sit: quam autem hìc definimus ea succus est, ex bono et percocto chylo genitus. Reliquas tum pituitae tum bilis differentias paulò pòst fusius persequemur.

Omnes humores simul gigni, et ab vno eodémque calore. Cap. IIII.

[P123] QUUM TAM multiplex sit et varia humorum natura, fierine potest ut omnium vna sit procreatio, et ab eodem calore profecta?

from the color of the spleen. Similarly, the blood that nourishes the liver is thick and red; it was appropriate for each [organ] to be nourished by congenial and kindred humor.

But the thicker component of the melancholic humor, being beyond softening or kneading by the spleen's power, and unsuited to nutrition, is expelled (belched out, so to speak) along its own duct into the mouth of the stomach. It is acrid and bitter, and so constricts and narrows the stomach, making its whole action sounder and stronger. Then it recedes into the gastric cavity, and emerges from there into the intestines, along with the food. Ultimately, a useless adjunct to the food leftovers, it is expelled outside along with them. It is not transferred again from there into the veins and liver anymore than the yellow bile, which was previously expelled and tinted the refuse of the bowel.

Yet another comparison with wine should be set before our eyes, if we choose to contemplate the origin and substance of phlegm. Wine now two months old, though cleared of sediment and scum, turns out to be pretty raw, dry, and astringent in taste, since it is imbued with raw particles too small to see. Over a number of days the heat of the wine overcomes and digests these; as evidence, anyone who tastes a wine one or two years old will find it now ripe, tasty, full of heat and strength. Likewise, in the case of blood from which both kinds of bile have been removed, a sort of raw humor permeates it throughout; nature has assigned no instrument to clear this out, since it ought not to be separated and removed. It is a sort of half-cooked nutriment, which stays with the blood and is carried with it into the veins, so as to be altered with time during hunger and famine, be fully digested, and turn into useful and healthy blood. This phlegm is not to be regarded as superfluous, as was said previously of melancholic humor and yellow bile, because it is capable of providing nutrition. Further, it is not like mucus dripping from the nostrils, nor like the sluggish thick phlegm that people maintain must be generated in the stomach and intestines, and which escapes concoction in the stomach, not being a juice at all; the phlegm we describe here is a juice, generated from good well-digested chyle. We will pursue the remaining differences of phlegm and bile more fully a little later on.

Chapter 4. All humors are generated at the same time, and from one and the same heat.

[P123] SINCE THE nature of humors is so manifold and diverse, is it possible that they all have a single process of generation, and one achieved from the

Sanguinem aiunt ex mediocri temperatōque calore nasci, reliquos humores ex immodico: quod ipsum variis argumentis fulcire nituntur, iisque ab hominum naturis, aetatibus, vitae generibus, ab anni tempore, regione et caeli statu ductis atque depromptis. Ex his enim quaecunque in calorem propensiora sunt, bilem, quae in frigus vergunt, pituitam: ut mediocria sanguinem gignunt. Si in hoc procreationis humorum summa causaque tota consistit, quum in vnoquoque homine calor vniusmodi sit et simplex, vnicus duntaxat humor proferetur. Et cui acior ille obtigerit, ex quouis sine discrimine tum calido tum frigido alimento, nihil praeter bilem gignet. Contrā verò cui natura aut aetate iam acta decursaque calor torpescit, tametsi calidiora erunt alimenta, meram pituitam procreabit. Haec autem per se et perspicue sunt falsa et inter se vehementer repugnantia, quae quotidie re et euentis refelluntur: quandoquidem in omnibus tum naturis tum aetatibus tum caeli constitutionibus, ex quocunque alimento, omnes humorum differentiae gignuntur in nobis. Dum enim alimentum sanguinis formam commutatione nanciscitur, reliqui humores pariter ortum habent. Itaque quoniam hominis simplex est et eiusdem naturae calor, consequens est hanc humorum differentiam non calori, sed alimento ascribendam esse. Atque ut apertius id explicem, locos eos penitus scrutabor ex quibus argumenta eruuntur. Nihil prorsus communi rerum natura ducitur et consistit, quod non quatuor illa peruulgata rerum primordia quadam mistionis temperatione compleant: maximè verò quae alimenta dicuntur ex illorum quadam mediocritate constant. Hinc fit, ut chylus ex alimento factus, quanquam simplex et vniusmodi intuentibus apparet, reuera tamen partium diuersarum mutua permistione concreuerit, quarum aliae calidae sunt et tenues, aliae frigidae et terrenae, frigidae aliae et humidae, ut aliae calore humoréque excellunt. Quum igitur vnus iocineris calor in tam varium et multififormem chylum agit, quid difficile existimes varios humores inde procreari, quando maximè à naturae interpretibus proditum est, ab efficiente causa simplici, complura diuersaque gigni, ob eam quae in materia est dissimilitudinem? Ut simplex omnino nullum potest alimenti aut chyli genus haberi, ita fieri non potest, ne ex grauissimo quidem morbo, ut omnes chyli partes in vnum simplicémque humorem commutentur. Etenim si quis melle, alliis, porris, aut caepris vescatur et vino meraciore, sitque is calidiore natura et aetate florenti, non idcirco duntaxat synceram ex his bilem, quanuis certè multam eam et feruidum sanguinem suscipiet. Cui iecur temperatum natura obtigerit, id ex ea chyli

same heat? It is said that blood is generated from a moderate and temperate heat, and the rest of the humors from an immoderate one. People strive to support this by various arguments, derived from human natures, ages, and kinds of life, from the season, the region, and the state of the heavens. Of these features, those that are more inclined to heat generate bile, those that tend to cold generate phlegm; similarly, the moderate ones generate blood. If the ultimate and whole cause of the generation of humors lies here, then when the heat in anyone is uniform and simple, just a single humor will be produced. If it has happened to be a rather bitter one, he will generate nothing but bile from any food indiscriminately, whether it is hot or cold. On the other hand, if his nature or his advanced age makes the heat sluggish, even when his foods are quite warm he will make pure phlegm.

These views are intrinsically and obviously false, and intensely inconsistent with each other; every day they are refuted by the truth and the outcomes. For in all natures, at all ages, and in all states of the heavens, all the different sorts of humors are generated in us from every sort of food; while food is changing to acquire the form of blood, the other humors are taking their origin at the same time. And so, as human heat is simple and of the same nature, it follows that this distinction between humors is not attributable to heat, but to food. To set this out more clearly, I shall thoroughly examine the positions from which the arguments are elicited. Absolutely nothing is originated by the general nature of things and comes into existence except what those four celebrated elementary stages of things make up, by a temperament of mixture. What are termed foods particularly consist of a moderate degree of them. Thus it comes about that chyle, made from food, simple and uniform though it may seem to the eye, is really composed of an intermixture of various parts: some are hot and rarefied, others cold and earthy, others cold and moist, in the same way as others are of notable heat and moistness. So, when the single heat of the liver operates on such complex chyle, why will you think it difficult for various humors to be made from it, when it has been very much the view of nature's interpreters that from a simple efficient cause many varied products can arise, because of the divergence in the material? As no kind of food or chyle whatever can be regarded as simple, even in the most serious disease all the parts of chyle cannot possibly be converted into a single simple humor. If someone feeds on honey, garlic, leeks, or onions, and undiluted wine, and is of a hotter nature and in his prime, he will not on that account receive just pure bile from them, although he will indeed receive a good deal of it and of hot blood. If anyone has been given a temperate liver by nature, it will make for him blood out of the part of the chyle

portione quae temperata sit et mediocri substantia sanguinem, ex calida et tenui bilem flauam, ex frigida humidâque pituitam, ex frigida atque terrena melancholicum humorem efficiet: omnia quidem sui generis quandam mediocritatem adepta. Si verò vel alimentum, vel iecur, vel vtrunque in calidum verget, bilis quidem abundantior efferetur, eâque calidior quemadmodum et sanguis: et pituitosus, aut melancholicus humor minus erit frigidus: nam vnusquisque humor certa temperamenti latitudine circumscribitur, per quam diuagari potest. Ex melle non modò copiosior, sed etiam calidior bilis quàm ex lactucis progignitur: et cui iecur est calidum, plus bilis eiûsque calidioris ex similia [*sic*; corrected to “simili” in Errata at end of the volume] alimento is coaceruat, quàm cui id in frigidum vergit. Est igitur sanguis alius alio calidior frigidiorve, et bilis bile calidior, et pituitosus melancholicusve humor alius alio frigidior, neque suus cuique ad vnguem definitus est gradus. Ex quo intelligitur non omnes quae in alimento ad bilem aptae sunt partes, in omnibus aequè corporibus in bilem conuerti, nec omnes quae pituitae gignendae sunt, semper in pituitam abire, sed varietatis plurimum afferri, ex efficientis caloris vi et alimenti materia, quarum iusta comparatio gignendi humoris speciem definiet. Rursum non omnem flauam bilis [*sic*; corrected to “bilem” in Errata at end of the volume] ab immoderato fieri calore, sed etiam à temperato, aliam quoque ab imbecillo: ridiculum enim et absonum videatur, siquis dicat temperatum aut frigidum iecur nil prorsum bilis habere, nec alimenta frigidiuscula illius quicquam [Pr24] proferre. Quod obiici solet bilem duntaxat fieri à natura, aetate, regione, et alimento calidiore, non est vsquequaque verum, quòd ab aliis etiam causis proueniat, attamen ab illis maximè redundantia quaedam fit et affluentia bilis supra mediocritatem: quemadmodum iecur et alimentum si frigidiora sint, pituita superfluet, si temperata, sanguinis erit vbertas: si temperatus calor et alimentum terrenum, melancholicus humor redundabit. Caeterùm non simpliciter ex similibus duntaxat causis singulos ortum habere necessitas est, quum omnes vt dixi ex eodem chylo vnus caloris beneficio producantur. Iam verò id multis aenigmatum obscuritatibus inuolutum explicare consilium est, vt humores quatuor simul et vno eodémque temporis spatio gignantur. Vnus quidem iocineris calor toti chylo aequaliter sese exhibet in eúmque pari robore et conatu vbique incumbit: veruntamen non eius partes omnes parem mutationis modum subeunt, quòd non similis sit omnium constitutio. Hinc accidit, vt qui ex his diuersi fiunt humores, eodem tempore emergant atque compareant. Pituita enim ex frigida et cruda chyli fit portione, bilis ex calida atque tenui, sanguis ex mediocri, melancholicus humor ex frigida atque terrena. Quoniam igitur vnus idémque

that is temperate and of medium substance, yellow bile out of the hot and rarefied part, phlegm out of the cold and moist part, and melancholic humor out of the cold and earthy part. They have all acquired some medium state of their kind. But if the food, or the liver, or both of them incline towards hotness, bile will be produced more amply, and hotter, as will be blood; and the phlegmatic or the melancholic humor will be less cold; each single humor is bounded by a fixed extent of temperament, over which it can range. Honey gives rise to a bile that is not only more abundant but also hotter than that from lettuces; and anyone who has a hot liver accumulates from similar food more bile, and hotter bile, than anyone whose liver tends to coldness. Therefore one blood is hotter or colder than another, and one bile is hotter than another, and one phlegmatic or melancholic humor colder than another; each does not have its own precisely determined level. Hence it follows that not all the parts in the food suited for bile are uniformly converted to bile in all bodies, nor do all those that are for making phlegm always turn into phlegm, but a great amount of variability is contributed from the power of the active heat and the material of the food; a correct balance of these will settle the form for bringing a humor into being. Again, not all yellow bile is generated from excessive heat, but some too from moderate heat and some even from weak heat. It would seem ludicrous and inconsistent for anyone to say that a temperate or cold liver has no bile at all, and that foods a little on the cold side [P124] produce none of it. The point usually made, that bile is just the product of hotter nature, age, region, and food, is not the whole truth, since it proceeds from other causes too, but these lead particularly to surplus and excess of bile, beyond the midpoint; for instance, if liver and food are rather cold, there will be a surplus of phlegm; if they are temperate, there will be a liberal supply of blood; if the heat is temperate and the food earthy, the melancholic humor will be present to excess.

But individual humors are not bound to take origin in simple fashion, just from similar causes, since (as I said) they are generated from the same chyle and thanks to a single heat. Now my plan is to clarify a question wrapped in numerous obscure riddles: how are four humors produced together in one and the same space of time? The one heat of the liver presents itself equally to the whole chyle, and bears upon it everywhere with equal power and effort; but not all its [the chyle's, presumably] parts undergo the same sort of alteration, because the character of all of them is not alike. Hence the various humors that arise from them come to make their appearance at the same time: phlegm from the cold raw part of chyle, bile from the hot rarefied part, blood from the intermediate part, melancholic humor from the cold earthy part. Since, therefore, one and the same

calor in chyli partes omnes aequaliter penetrat, easque afficit, quocunque tempore ex mediocri portione sanguinem effecerit, eodem ex calidiore bilem, ex cruda pituitam, ex terrena melancholicum humorem proferet: quum enim omnibus par elaboratio accesserit, tanta necessariò consurget humorum varietas. At iniquunt pituita frigidior est et crudior, ex hac deinde si perfectius coquatur, sanguis fiet, ex hoc demum caloris vi et exuperantia bilis: sic contendunt necesse esse vnumquodque prius leuiter quàm perfectè concoqui, sic gradatim ad summam perfectionem perueniri. His quidem rationibus vrgent et pungunt quasi aculeis, quas tamen refellere licet. Quanquam enim pituita dicitur sanguis leuiter et modicè coctus, aut sanguinis rudimentum et quasi adumbratio, et quae vi caloris perficiatur, fiatque sanguis: non tamen contra necesse est [sic] omnem sanguinem parcè concoctum pituitam dici, aut ex hac prouenisse, vt prius pituitae quàm sanguinis speciem acceperit. Hac enim ratione quicquid id est quo alimur, siue cibus, siue vniuersus chylus, pituita dici deberet, quia nondum plenam concoctionem obtinuit. Quinetiam si ex pituita totus fit sanguis, ex hoc deinde bilis flaua, postremò atra, vnus duntaxat humor erit in nobis, neque simul complures consistent. Deinde verò quia omnis humor coctione cogitur crassiorque fit, flaua bilis sanguine crassior euadet, nullus naturalis existet melancholicus humor, si ex bilis ardore gigni debet: nulla reddi poterit discernendorum humorum ratio, omnia funditus euertentur quae de illorum ortu et differentiis veterum praeceptis stabilita sunt. Non ergo humorum procreationes atque differentias ex vnus caloris vi et gradu, aut ex solis qualitatibus, sed etiam ex propria materia aestimabimus, quae sua est cuiusque humoris propria et familiaris. Alia quidem sanguini, alia melancholico succo, alia bili flauae subiecta est materia: neque fieri potest vt ex puro sanguine bilis gignatur et prodeat: sed vnumquemque necesse est ex conuenienti et idonea chyli portione gigni, idque simul et vnus eiusdémque efficientis caloris opera.

Vt sanguis à iecore delapsus per venam cauam in omnes corporis partes diffundatur. Cap. V.

POSTEAQUAM SUCCUS quem in iecore confici et ortum accipere demonstrauimus, à superuacaneis expurgatus fuerit, ruber iam et syncerus in eam venam perlabitur, quae in conuexo iocineris sita est et caua appellatur. Hoc autem loci

heat makes its way equally into all the parts of the chyle, and works upon them, it will produce bile from the hotter portion, phlegm from the raw portion, and melancholic humor from the earthy portion at the same time (whatever time it is) at which it has generated blood out of the intermediate portion. Since equal pains have been devoted to all, a comparably great variety of humors will inevitably develop. “But,” people say, “phlegm is colder and rawer, and if then it is more completely digested, blood will be its end product, and bile blood’s end product, through the power and excellence of heat. In this way,” they maintain, “each item must be concocted gently before being concocted completely, and thus is brought gradually to the peak of perfection.” With these arguments they goad and sting [us], but the arguments can be rebutted. Phlegm is said to be blood gently and moderately concocted, or an initial stage and (as it were) outline of blood, for completion by the power of heat to become blood; however, on the other hand all sparingly concocted blood does not have to be called phlegm, or to have originated from phlegm, so as to have taken on the form of phlegm before that of blood. On this basis whatever nourishes us, be it food or the whole of the chyle, ought to be called phlegm, because it has not yet secured complete concoction. Furthermore, if the whole of the blood originates from phlegm, then yellow bile from blood, and finally black bile, there will be just one humor in us, and several cannot coexist. Then, as every humor is concentrated by concoction and gets thicker, yellow bile will turn out thicker than blood, [and] there will be no natural melancholic humor, if it has to be generated from the heat of bile; no basis will possibly be available for humors being separated out, and all that the old teaching established about their origin and distinctions will be entirely overthrown. Accordingly, we will not assess the generating processes and differences of humors by the power and scale of a single heat, nor by qualities alone, but also by their own material, the one that is special and congenial to each humor. One material underlies blood, another melancholic juice, another yellow bile; and it is impossible for bile to be the product of pure blood, but each single [humor] must originate from a suitable portion of chyle, and at the same time and through the operation of one and the same active heat.

Chapter 5. How the blood slips out of the liver and is distributed through the vena cava to all parts of the body.

THE JUICE that we have shown was prepared and originated in the liver is now red and clear after being rid of redundant components, and slips into the vein that lies in the vault of the liver and is called the cava. This is the point at which

aquoso et tenui humore sanguis perfunditur, quo tanquam vehiculo facilè [*sic*] et expeditè in graciles et perquam angustas tum mensenterij [read “mesenterij” with 1542], tum iecoris venas permanat. Hic humor quoniam alendo corpori minimè est accommodatus, perfunctus iam illo vehendi munere, et ad reliqua deinceps inutilis, è iocineris conuexo secernitur et trahitur in renes, vnde mox profunditur in vesicam. Idcirco enim venae cauae vtrinque renes assident mox subter iecur positi, vt expeditiùs celeriùsque id muneris obeant. Caeterum non omnem eum humorem [P125] proliciunt, propterea quòd nonnihil illius retineri conuenit, quo reliquus sanguis per venas in omnes partes corporis pertinentes traducatur. Itaque renes per ductus venarum emulgentium vrinam eliciunt, ad id quidem incitati mutua et communi qua inter se conueniunt familiaritate. Per amplam eam ductuum laxitatem fieri vix potest, vt syncera illa atque pura trahatur, sed cum ea tum flauae bilis plurimum, tum sanguinis humidi ac tenuioris non modicum fertur. Vrina quidem et quae cum ea tenuior est bilis, potest per exiles transitus qui sunt in tunica succingente interiorem renum capacitatem elabi profundique in vesicam: at sanguis nempe illis crassior, inibi conseruatur, qui dein roris modo fusus renibus primùm apponitur, hinc annectitur, demum assimilatur, et in eorum substantiam facessit. Vrina quum praelongis validisque ductibus è renibus in vesicam depulsa fuerit, retrò com-
meare non potest, quòd obliqua sit ductuum in vesicam insertio. Coaceruatur autem illic et continetur vt proprio receptaculo, ne continenter et intempestiuè eam reddere cogamur. Quum verò illius influxu vesica iam turgescit, aut acrimonia ad illam reddendam impellitur, contractis quas in se continet transuersis fibris, vrinam propellit: idque simul relaxato ex rationis praescripto eo musculo qui in orbem agitur, et qui tanquam custos aliquis in ceruice positus, inhibet ne sponte proprioque impetu profluat vrina. Qui in abdomine sunt musculi non parum eam expulsionem adiuuant, potissimum dum ad imum ventrem constricti vesicam intrò protrudunt et impensè contrahunt. Quin et musculus ille in ceruice custos, dum sub finem emissae vrinae se comprimit et coarctat, omnes quae in ceruice sunt reliquias exprimit, maximè verò quum eae aut acrimonia aut arenis molestae sunt et graues. Vesicam vrina non alit, sed sanguis qui per peculiare venas vtrinque in illius ceruicem insertas influit, quemadmodum sanè tum vterum, tum bilis folliculum nutriri constat. Haec est omnis viscerum inferiorum nutritio, et superuacaneorum secretio, nunc quae reliqua sunt simili compendio persequamur.

the blood is imbued with watery thin humor; and carried along (so to speak) by it, it penetrates easily and quickly into the slender and very narrow veins both of mesentery and of liver. This humor is ill suited to nourishing the body, and its task of carrying done, it is of no use for what then remains, and is separated out from the vault of the liver and drawn into the kidneys, from where it runs out presently into the bladder. For this reason the kidneys adjoin the vena cava on each side, in their place just below the liver, so as to perform their function the more promptly. But they do not [P125] lure out all of the humor, because it is appropriate for some of it to be kept, to transfer the rest of the blood along the veins related to all the bodily parts. And so the kidneys extract urine through the channels of the emulgent veins, under the stimulus of the mutual relationship that brings them together. It is barely possible for the urine to be drawn along these wide limp channels in isolation; along with it travel both a great deal of yellow bile, and no small quantity of moist thinner blood. The urine, and the thinner bile accompanying it, can traverse slender paths in the coat surrounding the internal renal cavity and escape to run out into the bladder. But blood, of course thicker than these, is held there, and spreading out next like dew first applies itself to the kidneys, then bonds to them, and in the end is assimilated and departs into their substance. Urine, once expelled from the kidneys into the bladder along lengthy strong ducts, cannot retrace its path, because the insertion of the ducts into the bladder is oblique. It accumulates there and is held in what is its proper container, so that we are not forced to pass it continuously and at the wrong moment. But when the bladder is already getting distended by its inflow, or urged by corrosiveness to pass it, the transverse fibers the bladder contains contract, and the urine is ejected. This occurs at the same time as the muscle that tightens into a circle is relaxed by an instruction of the will, the muscle that serves as a sort of guardian at the [bladder] neck and prevents the urine running out on an impulse of its own. The muscles in the abdomen give considerable help to this ejection, especially when they constrict at the bottom of the belly, push into the bladder and contract without stint. Further, that guardian muscle in the neck, contracting itself at the end of urine emission, squeezes out all the residues in the neck, especially when they are a burden because of corrosiveness or the presence of gravel. Urine does not nourish the bladder; this is done by blood entering along special veins inserted into the bladder neck on both sides, in the way that it is clearly agreed both the womb and the gallbladder are nourished. This concludes the whole nutrition of the lower viscera, and the secretion of redundant matter; now let us take up the rest, with similar succinctness.

Quando iecur quidem sanguinis officina atque principium est, è quo tanquam è fonte alimentum defluere et in omne corpus diffundi conueniret, vt iustitiae quadam mediocritate sanguis vnicuique parti conferretur, venas inde tanquam à fonte riuulos sanguinem delaturos deduci par erat. Hae etenim si defuissent, quaecunque iecori viciniore sunt partes, exuperantis sanguinis copia obrutae mergerentur: quae verò longiore interuallo distant, ab hoc destitutae penuria languerent et extabescerent, quippe ad quas hic minimè permaneret. Quemadmodum igitur qui hortum aliquem summo artificio irrigare connituntur, ab ipso fonte aut ab amplo quodam riuo tubos complures, tum magnitudine tum spatiis discretos, in omnes horti partes deducunt, sic existimantes humorem quocunque trahi commodius et consequi posse: ita profectò per venarum productiones è iecore, partes corporis omnes iusta sanguinis mensura perfunduntur. At non vt aqua per riuulos, sic per venas sanguis sua sponte et impetu perlabitur: sed is tum iecoris vi expellitur, tum à propinquis venae partibus attrahitur, quae deinde in alias proximè consequentes extrudunt: ad huncque modum pellen-
tibus quidem prioribus, trahentibus verò iis quae deinceps subsequuntur, com-
moda fit sanguinis in extremas corporis partes distributio. Huc non parum momenti afferunt propriae singularum partium vires, quae naturali appetitu incitatae, id ex praeterlabente sanguine proleant, quod sibi tota substantia familiare est atque iucundum, idque proprio venae ductu ad se pertinente. Quae inter venas media interponuntur spatia, quanquam ductus non habent in se directos, alimentum tamen suscipiunt, nec praeparare vt aliquis putauerit, sed abundanter: id autem halitus specie per tenues occultosque propinquarum venarum transitus, tum excidit, tum rapitur. Non enim ex solis vasorum finibus et osculis, verum etiam, vt author est Aristoteles [*sic*], per quaeque angusta venarum foramina alimentum effluit, et illabatur in carnem in aliasque particulas. Distributionis huius non prius finis erit, quam in omnes corporis particulas nutrientis substantiae qualitas perlata sit. Verum hoc interim temporis spatio venae maiores quem in se continent sanguinem (nunquam enim otio perfruuntur) multò exquisitiùs elaborant et conficiunt, idque aut insita sibi vi et facultate, aut ea quam à iocinere [P126] illapsam acceperunt: id enim communi medicorum consensu firmatum est, sanguinem in venis summum perfectionis gradum adipisci. Sanguis autem simulac è venis amplioribus in angustiores, quas vnicuique parti natura dedit, attractus quasi deriuatione quadam exciderit, omni tum qualitate, tum proprietate circumstantis particulae

The liver is the workshop and source of the blood, the agreed place from which nutriment would flow out as through from a wellspring and be distributed into all the body, so that blood would be conveyed with moderation and fairness to every part; consequently it was reasonable that the veins stemmed from there, like channels from a spring for conveying the blood along. If they had not been there, all the parts closer to the liver would have been disastrously submerged by a flood of overflowing blood, while the parts further away would be enfeebled and wasted through lack of it, very little seeping through to them.

People who labor with the utmost ingenuity to irrigate a garden lead a number of pipes of various sizes and lengths into all parts of the garden, from the spring itself or from some wide river. They reckon that moisture can be drawn more conveniently along and follow in this way to reach everywhere. Thus undoubtedly all parts of the body are perfused with the correct ration of blood through venous extensions from the liver. But blood does not flow self-propelled through veins as water does through streams; it is both ejected by the liver's power, and drawn along by the parts adjacent to veins, which in turn expel it into others next in line. In this way, pushed by what came before and pulled by what follows next, blood is appropriately distributed to the remotest parts of the body. The special powers of individual parts contribute a good deal of effort to this; stimulated by natural appetite, they coax out of the passing blood the part congenial to them in its whole substance, and do so by the particular venous channel related to them. The intervals between veins lack channels running into them, yet take up nutriment, and not very sparingly either, as someone will have supposed, but liberally; in the form of breath, it slips out and is seized through the slender invisible passages of nearby veins. For nutriment does not flow out only from the ends and orifices of vessels, but also (on Aristotle's authority) through all the narrow pores of veins, and slips into flesh and other parts. There will be no end to this distribution until the quality of nourishing substance has been conveyed into every part of the body.

But while this is going on, the larger veins are never idle, but work upon and prepare the blood they contain much more meticulously, doing so either by their inherent power and faculty, or by one which has [P126] slid out from the liver and been taken up by them; it is established by the general agreement of physicians that blood acquires its highest level of preparation in the veins. As soon as blood has been drawn out of the wider veins into the narrower ones given by nature to every part, and has escaped as if along a sort of branch, it is gradually pervaded by every quality and property of the surrounding part; in

sensim perfunditur, eaque commutatione partis naturam assumens, fit primus humor ex quatuor secundariis quos antè commemorauimus. Dehinc verò per oscula aut caeca exilium venarum foramina, roris modo multiplici lapsu et erratico in omnem partis substantiam influit, pérque omnia spatia diffusus combibitur: fitque tum vera istius humoris appositio, quem non ineptè quis rorem appellauerit, quanquam non aquae similis est, sed superiore paulò crassior. Appositus iam hic contenter [read “continenter” with 1542 and 1554] assiduo partium calore conuertitur, concoctione cogitur crassiórque fit: deinde verò coactus parti agglutinatur et adhaerescit: éstque hic tertius humor ex secundis, qui partis tum qualitatem, tum temperamentum, nondum autem perfectam substantiam attingit. Ad extremum verò naturae vi et vniuersa partis substantia ita concrescit, ita mutationem subit, vt ei demum perfectè et vsquequaque assimiletur. Hoc opere quod veram nutritionem perhibemus, partis substantia quaedam fit carnosae, quam in secundariis humoribus loco quarto collocauimus. Itaque sanguis vt primùm in pusillas partium venas adductus fuerit, sensim mutatione ad illarum substantiam et temperamentum accedit, dum perfectè assimiletur, et ex toto expressam earum naturam referat, idque nutritione quae omnis concoctionis est finis, et summa totius functionis naturalis absolutio. Quocirca sanguis qui ossa, cartilagines, vincula, membranas, et neruos est nutriturus, Quodammodo (inquit Actuarius) in angustarum venarum extremitatibus iam albescit. Quum verò inter illarum partium fibras atque in media spatia illabitur, plenius sanè conuertitur, et quandam partis similitudinem gerit. Sic quae in ossium cauernulis est medulla (haec enim, non autem quae in maioribus capacitatibus concreuit, ossis est proximum alimentum) perspicuè iam ad ossis naturam accedit; cartilaginem mucco simile quiddam circumfundit: vinculis, membranis atque neruis lentus quidam humor circumiectus conspicitur. Tale autem est proximum cuiusque alimentum, quod quidem appositum iam est: deinde verò plenius confectum calore coactúmque parti agglutinatur et adhaeret, in eiúsque naturam tandem facessit, idque propria partis vi et facultate, quae propriae [read proprie] assimilans est, et altrix appellatur. Haec alia est in osse, alia in neruo, alia denique in aliis, vt sua insit cuique peculiaris. Simili prorsus ratione totidémque interpositis mutationibus caro alitur, non modò ea quae musculorum, sed et quae iecoris et quae reliquorum est viscerum. Quum enim sanguis è venarum osculis in carnem incidens ei apponitur, calore mutatus similem parti substantiam sumit,

this conversion it takes on the nature of the part, and turns into the first humor of the four secondary ones we discussed previously. Next, with a manifold wandering flow like dew, it runs through the orifices or blind pores of slender veins into the whole substance of the part, disperses through all the spaces, and is absorbed. It is then that the true contact takes place with this humor, which someone will have appropriately called “dew,” though it is not like water, but a little thicker than its predecessor. Now in contact, it is continuously altered by the constant heat of the parts, is condensed by concoction, and gets thicker; once condensed, it is attached to the part and sticks; and it is the third humor of the second ones, which achieves the quality and the temperament of the part, but not yet its complete substance. In the end, through the power of nature and the whole substance of the part, it congeals and undergoes change in such a fashion that it finishes completely and in every way assimilated to it. By this operation, which we regard as true nutrition, it turns into a fleshy substance of the part, which we placed in the fourth place among the secondary humors.

And so, when blood has first got drawn into the tiny veins of the parts, it is changed little by little to reach their substance and temperament, until it is completely assimilated, and reproduces their nature extracted from the whole, doing this by nutrition that is the conclusion of all concoction, and the ultimate natural completion of all function. This is why the blood, on its way to nourish the bones, cartilages, ligaments, membranes, and nerves, “now somehow turns white,” as Actuarius¹² says, “in the ends of narrow veins.” When it glides between the fibers of these parts and into the intervals, it is surely further altered, and shows some resemblance to the part. Thus, the marrow in the small recesses of bones (this is what is the immediate food of bone, not the marrow condensed in the greater cavities) now clearly attains the nature of bone; something like mucus¹³ envelops cartilage; a sort of viscous humor is visible enclosing ligaments, membranes, and nerves. This is what the immediate nutriment of each of these is like, now in contact [with them]. Next, with further preparation by heat and coagulation, it is attached to the part and sticks, and finally departs into the part’s nature, doing so by the part’s particular power and faculty, which is specifically assimilating, and is called the nourishing one. There is one like this in bone, one in nerve, and indeed another in other parts, so that each has its resident particular one.

Flesh is nourished on an altogether similar basis, and with the same number of intervening conversions; not just the flesh of muscles, but also the flesh of the liver and that of the rest of the viscera. For when blood escapes from venous orifices into flesh and is applied to it, it is changed by heat and takes on a

nec fieri potest quin medio ferè mutationis tempore crassior iam factus ei affigatur et adhaerescat. Caeterùm in hac multò celeriores fiunt mutationes, vt idcirco vix vllo sensu percipi possint, víxque fieri putentur. Carni enim proxima est sanguinis substantia, vt proinde leui facta mutatione ali possit: non sic autem ossa, cartilagine, vincula et membranae, vt à quibus sanguinis substantia longiùs abscessit. Non dissimili ratione nutriuntur venae et arteriae, quae quanquam proximum in se sanguinem continent, quo aluntur, hunc tamen non possunt leui momento in se conuertere: sed quae portio tunicis proximè assistit, primùm commutata albescit, móxque tanquam ros in angusta foramina venae aut arteriae rapitur, quibus penitus apposita crassiórque facta annectitur, tandémque assimilatur.

Quot concoctionum genera, quis cuiusque proprius sit humor, quod excrementum. Cap. VI.

FUNCTIONUM IGITUR quae natura duce ac magistra administrantur, summa atque suprema nutritio existit. Haec autem à natura fit, quae spiritus calorísque appulsu et opera, alimentum assiduè exagitat: id enim est tanquam subiecta materia in qua versatur, et in quam vires exercet suas, dum plenè et omnino in corporis substantiam sit conuersum. At non de repente, sed longa continuatáque rerum serie fit ea conuersio: multorum [P127] enim operis concurrentibus variè commutatur, expurgatur, in omne corpus distribuitur, huícque ad extremum assimilatur. In ea longa distributione, multiplex incidit concoctio, varij gignuntur humores, diuersa item superuacanea. Itaque assumptum alimentum quanquam vbique mutatur et omni corporis loco conuersionem subit (quandoquidem vnaquaeque corporis particula proprio calore, in id incumbit, et quasi culturam subigendo adhibet) non tamen vbicunque sit, concoqui id iure ac merito aliquispiam dixerit. Non enim quaeuis vel leuissima alimenti mutatio, qua id aut exteritur, aut mollitur, aut odore saporéve mutatur, sed duntaxat quae à natiuo calore fit in alimento perfecta substantiae conuersio, concoctio existit. Quae perfecta futura est concoctio, haud quidem exiguo breuíquue tempore, sed mora et cunctatione quadam absoluitur. Quocircà firmum ratúmque esse debet eo duntaxat loci hanc fieri, vbi alimentum diu multúmque haeret, et vis illa continendi valens est, simúlque concoquendi facultas copioso circumfluit et abundat calore. Hoc autem tribus tantummodo locis concessum videmus, è quibus etiam

substance like the part; now grown thicker almost within the course of the change, it cannot help becoming attached to the part. But many much faster changes occur in flesh, so fast that they can hardly be perceived by any sense, and are supposed hardly to occur. The substance of blood is the nearest to flesh, which can accordingly be nourished after a slight alteration [to the blood, evidently]; bones, cartilages, ligaments, and membranes are different, since the substance of blood has diverged rather far from them. Veins and arteries are nourished on a similar basis. Though they contain blood immediately adjacent to them, which nourishes them, they cannot convert it into themselves by a slight effort, but the part closest to the coats [of the blood vessel] is first to change and grows white. Next, it is taken up like dew into the narrow pores of the vein or artery, grows thicker in close contact with them, becomes attached, and is in the end assimilated.

Chapter 6. How many kinds of concoction there are, what the particular humor of each is, and what waste matter there is.

OF THE functions that are carried on with nature as leader and controller, nutrition is paramount. It is the work of nature, which under the effective impact of spirit and heat constantly stirs the food. The food serves as the subject material with which it is concerned, and on which it exerts its powers until it is fully and completely altered into body substance. This conversion is not instantaneous, but the outcome of a long unbroken sequence of events. The food is altered in various ways by widespread [P127] cooperation, it is purified, dispersed into all of the body and ultimately assimilated to it. During the long dispersal manifold concoction occurs, various humors are generated, and diverse redundant matters too. The food taken in is altered everywhere and undergoes change in every part of the body, because each individual part of the body applies itself to it with its own heat, and (so to speak) tills it. However, one cannot correctly and fairly say that it is concocted wherever it is. For a concoction is not just any minimal alteration to nutriment, crushing it, softening it, or changing its odor or taste; it is simply the complete conversion of substance in the food, brought about by the innate heat. A concoction that is going to reach completion is not achieved in a moment, but with some considerable lapse of time. Consequently it must be firmly agreed that this goes on just at the place where the food pauses long, and the well-known retaining power is effective, and at the same time the concocting faculty enjoys an abundant supply of heat around it. We see this condition met at just three places, and it is from them too

triplex existit concoctio, prima in ventriculo, secunda in iocinere, tertia in singulis particulis. Sua quanque antecedit praeparatio, suaque sequitur absolutio, suum cuiusque alimentum tanquam subiecta materia, suus genitus humor, suumque excrementum. Itaque prima omnium est chylosis, quae in ventriculo magna caloris vi perficitur, vertiturque multiplex et varium alimentum in quippiam vnius substantiae, candidum id quidem et ptissanae³ cremori persimile. Huius praeparatio quaedam praegressa est in ore, qua non atteritur modò et molitur cibus, sed et leuem conuersionem subit, qualem manifestò cernimus in subrubro vino, quod pauco momento ore conceptum tum ardorem tum ruborem deponit. Eius autem absolutio in intestinis est, quae ipsa modicam concoquendi more ventriculi vim obtinent. Quanquam enim è ventriculo valente et cui integritas est valetudinis, nihil prorsus excidit quod non plenam concoctionem acceperit, si quidem ad hanc aptum erat: quoniam tamen innatus partium calor nunquam otiosus conquiescit, necesse est quaecunque in intestina illabuntur perfectius quodammodo mitigari et concoqui. Secunda concoctio celebratur in iocinere, αἰμάτωσις Graecis appellata. Hac enim chylus è ventre haustus, propria iecoris vi quae in eius substantia potissimum insidet, in veram sanguinis speciem conuertitur, quam à chylo constat non modò colore, sed etiam vniuersa substantia planè diuersam esse. Hic sanè adumbrationem quandam in venis mesenterij prius acceperit, in quibus iam ruber conspicitur, perpolitur verò in vena caua aliisque maioribus, in quas è iecore lapsus confluit. Vires enim habent venae non solùm continendi distribuendique sanguinis, sed etiam concoquendi, hasque à iocinere originis suae principio et quasi fonte, quemadmodum à ventriculo intestina mutantur. Tertia concoctio in partibus fit singulis, qua appositus adiectusque sanguis iam à priore natura deficiens, in idoneam alendae parti substantiam conuertitur. Haec rudimentum quoddam et primordium capit in venis exilibus, in quibus antè diximus sanguinem à partis natura et calore iam mutari: eius autem absolutio est perfecta assimilatio atque nutritio, omnium concoctionum finis. Priores duae concoctiones, in communem totius corporis commoditatem et vsum comparatae sunt, at tertia peculiaris est et iam parti cuique sua, neque hanc idcirco pars vlla parat et molitur vt alteri cuiquam parti, sed vt sibi duntaxat commodet atque prosit. Mammae quidem et quaecunque in eis sunt glandes raptò tractoque sanguine aluntur, hunc in suam naturam conuertunt: at insuper

that threefold concoction arises: the first in the stomach, the second in the liver, the third in individual parts. Each is preceded by its own preparation and followed by its own completion; each has its own food as its subject material, its own generated humor, and its own waste matter.

And so the first concoction of all is chylification, which is carried out in the stomach by the great power of heat, and diverse food is converted into something of one substance, white and very like cream of ptisan.¹⁴ Some preparation for this stage has already occurred in the mouth, where the food is not only ground up and softened, but also undergoes a modest change, such as is obvious in reddish wine: taken into the mouth for a brief moment, it relinquishes both its fire and its redness. The stage's completion is in the intestines, which themselves possess a moderate power of concoction, like the stomach. Out of a stomach of unimpaired health nothing whatever escapes that has not undergone a full concoction, so long as it is suitable for concoction. However, as the innate heat of parts never lies idle and inactive, inevitably anything that flows into the intestines is in some way more completely modified and concocted.

The second concoction is carried out in the liver; the Greeks call it hematosis. In it, chyle absorbed from the stomach is converted into the genuine form of blood, by the particular power of the liver that dwells especially in its substance. It is accepted that this form differs completely from chyle, not only in color, but in the whole of its substance. The blood certainly acquired a sort of outline previously in the mesenteric veins, where it is already visibly red, but the finishing touches are given in the vena cava and the other larger veins, into which it flows out from the liver; veins have powers not only to hold and distribute blood, but also to concoct it, and borrow them from the liver, the original wellspring of their beginning, just as the intestines borrow theirs from the stomach.

The third concoction takes place in individual parts, and by it blood that is in contact and attached, and already departing from its earlier nature, is changed into substance suitable for the nourishment of the part. This acquires an initial stage in the slender veins where we said previously that blood was already being changed by the nature and heat of the part. The completion of this is total assimilation and nutrition, the fulfillment of all concoctions. The first two concoctions are provided for the general convenience and use of the whole body, but the third is now specific for each part, and consequently no part prepares and performs it for the benefit and convenience of any other part, but only for its own. The breasts and all the glands in them are nourished by blood grasped and drawn in, which they alter into their own nature; in addition, out of

eadem ex redundanti functionis vbertate lac generant, quo partus alatur. Sic testes per vasa seminis adducto sanguine conuersóque se nutriunt, qui adultis praestantia roboris excellentes semen efficiunt, ex quo deinde procreatio fit et generis conseruatio. Quanquam autem hae partes actione sua non se solùm, sed alia [*sic*] quoque iuuant, quoniam tamen haec extra corpus sunt, neque in illius dominatu, non vtique generalis, sed peculiaris duntaxat concoctio dici debet. Quot partium in humano corpore sunt differentiae, totidem statuere licet peculiarium concoctionum varietates. Primae autem illius generalis ad nutriendum idoneus humor in ventriculo genitus, proprio nomine chylus appellatur, et primum quod in corpore consistit alimentum. [P128] Huius autem excrementum est stercus Graecis ἀποχώρημα et σκατόν,⁴ quod reuera in ventriculo cum vtili substantia confusum erat: sed cum postea è ventriculo et è superioribus gracilibúsque intestinis chyli portio tenuior rapitur in iecur, reliqua crassior, impurior, et fecis aemula, in caecum intestinum vel in colum, mox in aluum irruit, vbi primùm fex alui dici solet. Alterius concoctionis vtilis humor est sanguis, aut si vniuersa complecti volumus, omnis humor quicunque à Graecis χυμός, à nobis succus appellatur: quo nomine non modò purum syncerúmque sanguinem, sed eos etiam qui cum sanguine gignuntur humores naturales quidem et nutritioni accommodatos designamus. Superuacaneum autem eius est vrina, quae è iecore et venis prolectatur in renes, ac profunditur in vesicam; similiter melancholicus humor quem lienis ad se rapit, ex crassa terrenáque chyli portione factus, quae naturae concoctionem subterfugit, neque potuit iecoris vi mutari. Est et tertium eius excrementum flaua bilis ea quae in fellis vesiculam reconditur: ex tenuissima haec calidissimáque chyli portione (qualis plurimùm est pinguis atque dulcis) assa et torrida, quasi flammeam acrimoniam assumit: quocirca excrementum verè est, omnino superuacuum nec alendo corporis accommodatum. Qui autem iam ab his expurgatus est reliquus humor, purus est et mediocris succus atque secundum animantis alimentum, quod in omnes partes distribuitur. Tertiae concoctionis opus et vtilis succus est vniuersum eorum humorum genus, quos aliquando diximus secundarios appellari, in quorum ordine eum primum collocauimus, qui in exilibus est partium venis, secundum qui tanquam ros in partes influit eisque apponitur, tertium qui affigitur, quartum qui iam in partis substantiam concedit eíque assimilatur. Huius quidem superuacanea sunt, quaecunque vaporis specie sine sensu per cutis spiracula exhalantur, et quae paulò crassiora sordium

the abounding richness of their function they create milk to nourish offspring. In this way the testicles nourish themselves with blood drawn and converted along the seminal vessels; in adults, they surpass in notable strength, and generate semen, from which later on procreation and the preservation of the race come about. These parts do not assist just themselves by their activity, but others too; however, as these others are outside the body and not within its control, it must not be called unconditionally a general concoction, but just a special one. As many sorts of special concoctions can be established as there are distinctions of the parts in the human body. The appropriate humor of that first general concoction for nutrition is generated in the stomach, and called by its own name "chyle"; it is the first nutriment present in the body. [P128] Its waste matter is dung, in Greek *apochorema* and *skaton*, which was actually mingled in the stomach with useful substance; but when later on the thinner portion of the chyle is carried off into the liver from the stomach and the upper and thinner intestines, the remainder, thicker, less pure, and resembling sediment, rushes into the caecum or colon, and then into the rectum, where first it is usually called the rectum's sediment ["fex" or "faex," plural "feces"]. The useful humor of the second concoction is blood, or if we seek to be comprehensive, every humor that is called *chymus* in Greek and juice by us; under this name we describe not only pure uncontaminated blood, but also the natural humors that are generated with blood and are adapted to nutrition. Its waste matter is urine, which is coaxed out of the liver and veins into the kidneys, and pours out into the bladder; in a similar way the melancholic humor, which the spleen grasps to itself, is made from the thick earthy part of the chyle, which evades the natural concoction, and cannot be altered by the power of the liver. Its waste matter, the third one, is yellow bile, the bile stored in the gallbladder: derived from the thinnest and hottest part of the chyle (most of it is of a fatty and sweet sort), it is dry and hot, and takes on a flamelike corrosiveness; hence it is really waste matter, entirely superfluous and unsuited to bodily nourishment.

The remaining humor, now cleared of these, is a pure and moderate juice, the second nutriment of an animal, and is distributed to all parts. The product and useful juice of the third concoction is all that kind of humors that we said previously were called secondary; we placed first among them the one in the slender veins of the parts, second the one that flows into the parts like dew and lies on them, third the one that is attached, fourth the one that already passes into the substance of the part and is assimilated to it. Its waste matters are all those that are exhaled insensibly through the skin's vents in the form of vapor, and those that are a little thicker and stick to the skin surface, in the form of dirt

strigmentorúmque⁵ specie cuti extrinsecus adhaerescunt, et sudores qui tanquam reliquiae sunt serosi humoris illuc euecti, et tenui bile perfusi. Hi enim si corpus patens nec cutis densa est, plerunque modicè erumpunt, idque sponte et naturaliter. Qui verò per se extra modum emanant, ab humore quodam inutili praeter naturam fluunt, neque possunt inter naturalia excrementa referri, vt neque puris, neque saniei, neque tuberculorum eruptio. Rursum qui à manifestis causis, vt a balneis, ab immoderata exercitatione, ab aestu fiunt sudores, non modò hoc excrementi genus, sed vtiles quoque humoris, nonnunquam et tenuioris sanguinis quippiam proliciunt atque dissipant. Isthac quidem superuacanea sunt communia et quae ab omnibus particulis promiscuè dimanant, maximè à musculis et ab aliis quae extrinsecus circumiectae sunt partes. Praeter haec alia quaedam in conspectum se dant, sua quibusque partibus peculiaria, quemadmodum pili et vngues partium solidarum sunt excrementa, renum autem et vesicae ea quae cum vrinis redduntur, lienis quod in os ventriculi refunditur, pulmonum sputa quotidiana, cerebri excrementum est id, quod tum per palatum tum per nares defluit et emungitur, βλέννα et μύξα, id est mucus, aut κόρυζα, id est destillatio solet appellari. Id enim ex cerebri nutritione tanquam inutile relictum est, retinétque quandam illius constitutionem frigidam atque humidam, quúmque ex vniuerso cerebri corpore in amplos eius ventriculos abundantius congestum fuerit, tum demum illinc per palatum et nares exigitur. Quanquam autem id pituitae temperamentum accepisse videtur, nequaquam tamen verè pituita est, haec quippe in solo iecore gignitur, et in vitilium succorum numero censetur: illud cerebri planè excrementum est: haec potest in sanguinem concoctione conuerti, illud nunquam, sed caloris vi siccescit et in tophos cogitur. Huius speciem praesefert ea quae in ventriculo et in intestinis gigni procrearique solet: pituita enim non est, sed ne succus quidem omnino: concoctionis autem primae cruditas est quae euinci non potuit, vel ex cibi crassa et tenaci natura, vel ex ventriculi intestinorúmque imbecillitate concreescens. Quum etiam exanguis membranosaque sit ventriculi et intestinorum substantia, necesse est et propria illorum excrementa (fex enim alui commune excrementum est) alba, frigida, lentáque inueniri.

De sanguine, vtque is consistat in venis. Cap. VII.

[P129] LICET È iecore erumpens sanguis in venas, ab omni superuacaneo humore purus expurgátisque sit, non tamen simplex is omnino est ac vnusmodi: sed ex variis eum substantiis constare demonstrat, tum ortus nostri tum alendarum partium necessitas. Harum enim alia calidior

and skin scrapings, and sweats, which are carried out there as the remains of watery humor, and are pervaded with thin bile. If the body is open and the skin not thick, these usually burst out moderately, and deliberately and naturally. But sweats that issue excessively of themselves, flow preternaturally because of some useless humor, and cannot be assigned among the natural wastes, unlike the discharge of pus or gore or tubercles. Again, sweats that occur from obvious causes, such as baths, excessive exercise, or hot weather, lure out and disperse not only this kind of waste, but also some useful humor, and on occasion some thinner blood. These superfluous matters are general and percolate from all parts indiscriminately, especially from muscles and from other parts surrounding the body externally. In addition, other things present themselves to view, special to particular parts, in the way that hair and nails are waste of solid parts, items that are excreted with the urine are waste of the kidneys and bladder, what flows back into the gastric mouth is waste of the spleen, the daily spittle is waste of the lungs, and the brain's waste is what runs down through the palate and nostrils and is wiped away, usually called "blenna" and "muxa" (i.e., snot), or "coryza" (i.e., catarrh). This is left behind from the nutrition of the brain as of no use, and retains something of its cold and moist character; when it has been gathered more plentifully out of the whole body of the brain into its wide ventricles, it ends by being expelled from there through the palate and nostrils. Although it appears to have acquired the temperament of phlegm, it is not really phlegm at all; phlegm is generated only in the liver, and is on the list of useful juices; the other is clearly waste of the brain. Phlegm can be changed into blood by concoction, but the other never can; it dries up through the power of heat, and is collected into tophi. What is usually generated in the stomach and intestines presents the form of phlegm, but is not phlegm, nor indeed a juice at all; it is indigestible matter of the first concoction that could not be overcome, solidifying either through the thick clinging nature of the food, or the feebleness of the stomach and intestines. Also, since the substance of the stomach and intestines is bloodless and membranous, their own wastes inevitably turn out white, cold, and viscous (sediment ["fex"] is the general waste of the bowel).

Chapter 7. Blood, and how it is present in veins.

[P129] ALTHOUGH BLOOD bursting out from the liver into the veins is cleared of all superfluous humor, still it is not completely simple and uniform, but is shown to consist of a variety of substances, by the requirements ["necessitas"] of our origin and of the nourishing of the parts. One such is detectably hotter, one

percipitur, frigidior alia, rursus alia mollior, alia durior, quae vt non omnes ex eadem similique substantia nasci, ita nec eadem nutriri sustentarique possunt. Seminis è quo gignimur materiam palam est, non prorsum vnus esse modi, sed in ea partes consistere varias, adhiberi que crassiorem portionem solidis, humidam mollioribus, calidam calidioribus, frigidamque frigidis. Et quum deinceps corporis partes aluntur ex sanguine, singulas ex simili quadam et idonea materia nutriri et increscere, vt idcirco non simplex, sed mixtus atque compositus etiam in aetate prouectis, sanguis appareat. Quomodo enim partium naturae tam variè et longissimè à se dissidentes, ex vna eademque prorsus materia commodè vitam suam tumentur? Semina in terram proiecta, itemque stirpes non vno omnes alimento sustentantur, sed alia dulcem è terra succum, alia salsum, amarum alia, denique vnaquaeque quod sibi familiare est et amicum pro alimento haurit, à quo si fortè destituatur, mox extabescit et emoritur. Tantùmne in stirpes beneficium atque priuilegium natura contulerit, hominibus negauerit? In tam immensa hominum et temperaturarum varietate, omnesne eodem similique cibo gaudebunt? Si non omnes vna cibi substantia aequè seruat ac sustinet, neque profectò tam multis et variis partibus quae in nobis sunt alendis, simplex vnum atque purum succi genus satis esse potest. Itaque sanguis qui è iecore emersit maioribusque venis concluditur, exquisitè vnus et purus esse non potest. Id verò apertè in eo conspicitur, qui secta vena ex integrè sano corpore sit emissus. Nam praeter serum in reliquo quod concreuit partes spectantur planè dissimiles: alia quidem tenuis, subrubra ac feruida per summa innatans, alia in imo crassa, subnigra ac verè terrena, alia medio situ in istarum mediocritate consistens, per quas et quarta quaedam portio crudior effusa est. Quicquid in hac concretionem cernitur, medici iuxta ac philosophi sanguinem appellant, qui communi sententia omnes corporis partes solo sanguine nutriri, id est iusta quatuor succorum commoderatione pronuntiant. Quid igitur (inquies) vitiosumne fuerit sanguinem purissimam in nobis contineri? Si enim debet is ex variis partibus ad nutriendum constare, videtur non esse procurandum vt purus atque syncerus in nobis gignatur, sed alimentorum vsu varij succi erunt in nobis accersendi. Est hoc (fateor quidem) necesse, veruntamen non idcirco quaerenda sunt alimenta, quae varios illos procreent, sed omnes ex optimo et purissimo quoque procedunt: vixque vlla viuendi ratio et facultas efficit, vt syncerus sanguis in venis coaceruetur, qui tamen si talis consistat, nihil incommodi quicquam est allaturus. Porro autem quicquid illud est in venis contentum, quod in partium corporis substantiam facessere debet, sanguinem

colder, yet another softer, another harder, and as they cannot all be born of the same like substance, they cannot be nourished and supported by the same substance either. It is evident that the material of the seed whence we are generated is not completely of one sort; a variety of parts are present in it, and a thicker one is employed for solids, a moist one for softer parts, a hot one for hotter parts, and a cold one for cold parts; also that when the parts of the body are nourished in succession from the blood, individual parts are nourished and get their increase from similar and suitable material. Hence it is found that blood is not simple, but mixed and a composite, even in old age. For how could natural parts differing so very widely from each other maintain their life adequately out of one and entirely the same material? Seed thrown onto the earth and plants too are not all supported by one nutriment: one absorbs sweet juice from the earth, another salty, another bitter; in short, each absorbs for nutriment what is congenial to it, and if by chance deprived of it, soon wastes away and perishes. Could nature have conferred such a great special advantage on plants, and denied it to man? Men and temperaments are an enormous variety: will they all enjoy the same and similar food? If one food substance does not maintain all of them equally, no more can one simple pure kind of juice suffice for so great a multitude of diverse parts that need nourishment in us. And so blood that has made its way out of the liver and is contained within the great veins cannot be exactly single and pure, as is clearly seen in blood drawn by venesection from a completely healthy body; over and above the serum, parts are seen in the rest that has clotted that are entirely different: one thin, reddish, and hot, floating on the top; another at the bottom, thick, darkish, and truly earthy; another in the middle position, and intermediate between them, and diffused through them a fourth part too, less developed ["crudior"]. Physicians join with philosophers in calling all that is visible in this clot blood, and they are unanimous in proclaiming that all parts of the body are nourished by blood alone, that is, by a correct blend of the four juices.

"What shortcoming will there be," you will say, "in very pure blood being within us?" If it needs to be collected from various parts for nourishing, arranging for it to be generated pure within us seems wrong; instead, through using foods a variety of juices will need to be summoned up within us. I acknowledge the need; but foods are not to be sought so as to produce those various juices; they all proceed from each excellent and very pure item [presumably each such food]. There is hardly any basis and faculty for living that brings it about that pure ["syncerus"] blood accumulates in the veins, yet if it is so, it is not going to lead to any harm. Further, we regard as blood whatever is within

id perhibemus. Hoc quidem discrimine à caeteris seiunctum humoribus, quòd è venis siue foras, siue in ventrem, siue in vesicam, siue in vterum, siue in intestina, siue in thoracis spacium, siue in aliam denique capacitatem excidat, concrescit in grumum, quod caeterorum humorum nulli est concessum. Proxima autem et continens concretionis causa, fibrae eae sunt, quas cunctorum animantium sanguis confusas in se continet. Neque enim ceruos neque damas, de hoc numero, vt Aristoteles fecit, auferam et excludam, nimirum in quibus iugulatis etsi non summè, coire tamen sanguinem videmus. Quod si à concrectione alienus omnino is foret, nec corporis alendi, nec in solidiorem substantiam se conuertendi vim et potestatem haberet. Ita verò accuratè diligentérque sanguini confusae sunt fibrae, ita perturbatae, nihil vt sensus in calido etiamnunc sanguine possit percipere, nihil vt in eo qui iam frigore coiuit et congelauit. Veruntamen seiungi hae separarique hac ratione consueuerunt, si vel calens tepidúsque sanguis per linteum transfundatur, vel crebra agitatione bacillo manúve concutiatum dum refrixerit, quo modo solent mulierculae suillum praeparare. Quinetiam quum [P130] incisa in malleolo saphena, sanguis vt mos est in peluim tepentis aquae profunditur, mox vt haec refrixerit et ad exiguum tempus constiterit, tota tenuiore sanguinis portione tingetur, ad fundum autem delabentur fibrae illae prorsus cohaerentes et albae, quae quàm plurimos specie quadam assimilatae pituitae in errorem induxerunt. Hae quotiescunque exemptae detractaeque fuerint, reliquus sanguis et à concrescendi ratione in quam sua sponte ferretur, et à nutriendi praestantia longissimè distabit. Fibras quidem chylus prima concoctione contrahit è ventriculo, qui ferè totus quum neruosus sit, suam illis substantiam quadantenus impertit, qualem obtinere videmus tum eorum plurima quae vomitione redduntur, tum propria ventriculi intestinorúmque excrementa, summè nimirum pituitosa ac lenta, illapsus dein chylus in iecur, veram sanguinis substantiam colorémque adipiscitur. Itaque concrescendi vim sanguis habet è ventriculo, cuius errore corpus omne quasi atrophiam plerunque extabescit, sanguine fibris destituto. Hinc non paucos cernimus macie confectos, quibus tamen sanguis copiosus inest, ísque benè temperatus: alios opimum corporis habitum et carnis molem consequi, licet sanguine constant calidiore. Maxima igitur et admirabilis in sanguine facultas, sed et magna vis est venarum, quae conceptum sanguinem coire nunquam sinunt, nisi fortasse ex rara quadam et abdita morbi causa, ex qua vidimus quempiam post diuturnum languorem de vita exiisse, cui sanguis vniuersus in venis concreuerat, adeò vt demum coralli

the veins and must depart into the substance of the body's parts. This is what distinguishes it from the other humors: if it escapes from the veins to the outside, or into the belly, or the bladder, or the womb, or the intestines, or the thoracic space, or indeed any other cavity, it coalesces into a clot, which is not a property of any other humors. The proximate and adjacent cause of clotting is the fibers that every animal's blood contains dispersed within it. I shall not make an exception of deer or chamois, as Aristotle did, since we do see the blood clot in those that are strangled, though incompletely; if it were entirely incompatible with clotting, it would lack the power and ability to nourish the body and change itself into more solid substance.

The fibers are so carefully mingled with the blood, and in such disorder, that the senses can make out nothing while blood is still warm, nor in it when coagulated and frozen by cold. But they have customarily been separated by passing warm or cool blood through linen, or by vigorous stirring with a stick or one's hand while it chilled, in the way that women get pork broth ready. Further, when the saphenous vein has been cut at the [P130] malleolus, the blood runs out in the usual fashion into a basin of warm water, and soon after it has chilled and stood for a short while, all the water will be colored by the thinner part of the blood, but those fibers stick completely together, are white, and will sink to the bottom; they have misled very many people by a certain resemblance to assimilated phlegm. Every time that they have been extracted, the rest of the blood will diverge very far from the clotting behavior to which its own inclination was leading it, and from excellence as nutriment. At the first concoction the chyle draws fibers out of the stomach, and the stomach, being almost entirely composed of nerve ["neruosus"], conveys its own substance to them to some extent, substance of the sort we see possessed by a great deal of what is returned by vomiting, and by the particular refuse of the stomach and intestines, which is of course extremely phlegmlike and viscous. Then the chyle slides into the liver and takes on the true substance and color of blood.

And so blood acquires the power of clotting from the stomach, which if defective generally makes the whole body waste away with (so to speak) atrophy, the blood having been deprived of its fibers. This is why we see many wizened people who still contain plenty of blood, and well-tempered blood too; and others who possess a plump physique and bulk of flesh, although they exist with hotter blood. So a very great and marvelous faculty resides in blood, but the veins have a great power too, and never allow the blood in them to clot, except perhaps from some rare and occult cause of disease, through which we have seen someone perish after prolonged weakness, in whom all the blood in his veins had clotted, so as to be taken out of them finally sprouting like coral.

modo fruticans illinc eximeretur. Non igitur, quemadmodum Aristoteles affirmat, conseruandi sanguinis facultas in venis est ex caloris tepore, quum et reliquum corpus omne tepescat, sed ex ingenita quadam vi et familiaritate, quae profectò efficit vt hae naturalis et legitimus locus sint sanguinis. Huius apertum id esto inditium, quòd in mortuorum venis refrigeratus etiam sanguis non concreseat, quem tamen in viuientium intestina, aut in ventriculum ac vesicam irruentem, tepor à concretione non praeseruat. Quicquid igitur venae concludunt et intra se cohibent, siue crassum id atque nigrum sit, vt liquidam picem repraesentet, siue flauum, siue prorsus album aut liuidum, cuiuscunque demum substantiae sit aut caloris, si ex his profusum mox durescit atque coit, id vniuersum sanguinis appellatione complectemur: quanquam non omnis huiusmodi, secundum naturam esse, et vitio carere existimandus est.

Sanguinem in venis, non trium, sed quatuor humorum permistione contineri, quòtque eius sint differentiae. Cap. VIII.

QUALISCUNQUE AUTEM is fuerit, chymus id est succus appellatur, qui interdum bonus est, vt in euchymia, interdum malus, vt in cacochymia: et vterque quoniam in partium substantiam effusus fibrarum vi concreseat atque coit, alere dicitur. Sed bonus, qualis in bono atque etiam in athletico habitu consistit, probè, malus verò vitiosè, vt in vtroque ictero, in leucophlegmatia. Qui porrò bonus ac laudabilis est sanguis, ex partibus constat et substantia et temperamento et colore variis. Has bonos succos appellant, quibus ex quadam temperamenti affinitate humorum superuacuorum nomina sunt indita. Nam sanguinis pars tenuissima calidissimèque, bilis etiam appellatur, melancholicus succus, pars quae crassa, frigida, siccèque est: pituita, quae cruda nempe frigida est et humida: sola verò ea quae tum substantiae, tum qualitatum mediocritate quadam continetur, peculiari sanguinis appellatione notatur. Non defuerunt qui sanguinem vniuersum existimauerint non ex quatuor, sed ex tribus duntaxat permistis succis constare, nempe ex pituita, et bile tum flaua, tum atra. Hi non aliud esse sanguinem putant, quàm trium succorum mediocrem et commodatam permistionem: neque praeter hos quartum sanguinem purum in venis contineri, sed ne cogitatione quidem percipi contendunt, hac potissimum ratione, quòd seorsum tres humores positi sunt, sanguis autem purus nullus extat. Addunt sanguinem dum corrumpitur, in tres eos omnino humores conuertere, neque sanguinis quicquam seorsum manere. Cùm igitur tres hi succi aequabiliter aucti sunt, sanguinem per id temporis dominari ferunt, sin inaequabiliter, eum duntaxat

So what Aristotle said is not true, that the faculty of preserving the blood in the veins is due to the warmth of their heat, since the rest of the body is all warm too; it is due to an inherent power and close association, which undoubtedly brings it about that they are the natural and right place for the blood. Let the obvious evidence of this be that in the veins of corpses, blood does not clot even though chilled, yet when it is rushing out into the intestines of the living, or into the stomach and bladder, the warmth does not prevent it from clotting. Therefore, all that veins enclose inside them, be it thick and black like liquid pitch, or yellow, or entirely white or livid, indeed of whatever substance or heat it is, if it flows out of them and presently hardens and clots, we include the whole of this under the name "blood"; however, not everything like this is to be regarded as in accord with nature and free from defect.

Chapter 8. Blood in the veins consists of a mixture not of three but of four humors, and what the different sorts of it are.

WHATEVER IT has been like, it is called chyme, that is, a juice,¹⁵ which sometimes is good (as in euchymia) and sometimes bad (as in cacochymia); and each is said to nourish, since when it runs out into the substance of the parts it clots and contracts, through the power of its fibers. But good chyme, such as is present in a good and also in an athletic physique, does this properly, while bad chyme does it faultily, as happens in both sorts of jaundice and in leucophlegmasia.¹⁶ Again, good and praiseworthy blood consists of diverse parts, substance, temperament, and color. They describe as good juices those that possess the names of redundant humors, through some association of temperament. For the thinnest and hottest part of blood is also named bile; and the thick, cold, dry part, melancholic juice; and the less digested (meaning cold and wet) part, phlegm; only the part that is associated with a medium level of substance and of qualities is identified by the special name of blood. There has been no lack of people who believed that whole blood consisted not of four but just of three mixed juices, meaning phlegm, yellow and black bile. They think blood is simply an intermediate moderate mixture of three juices, and that there is no fourth pure blood in the veins over and above those; they hold that it cannot even be perceived in thought, particularly on the basis that three humors have separate places, but no blood exists pure. They add that when blood decays, it is entirely changed to these three humors, and none of the blood remains over. So when these three juices are equally increased, they put it that blood has the upper hand at the time; but if the increases are unequal, just the one that

qui reliquis est superior, à quo totum sanguinem aut pitui-[P131] tosum, aut biliosum, aut melancholicum dici volunt. Simillimam demum in lacte rationem haberi, quod tribus duntaxat substantiis continetur, praeter quas nulla est quarta, quae lactis nomine designetur, sed totum quod ex iis tribus idoneè temperatis consistit, lactis nomen sibi assumere. At verò si partes chyli intentis oculis et animo cernemus, et eas tum ex substantia, tum ex qualitatum coniugationibus spectabimus, non modò tres, sed quatuor fient earum differentiae, ex quibus quatuor etiam succi proueniunt. Quinetiam si partium corporis, quas hi nutrire debent varietas perpendetur, vt quaedam se offerent, ad quas tres reliqui humores accommodari possunt, ita quaedam etiam deprehenduntur calidae et humidae vt caro, quaedam temperatae vt cutis, quae non nisi puriore sanguine nutrirì possunt. Quocirca necesse omnino est, praeter tres reliquos succos, purum sanguinem etiam in venis haberi, eúmque longè reliquos multúmque superare. Inepta igitur et iniqua censi debet sanguinis cum lacte collatio: nec dum sanguis corrumpitur, vniuersa eius substantia in bilem tum atram, tum flauam facessit, sed etiam pars quaedam manet, aut nondum corrupta, aut corrupti sanguinis speciem ostendens. Itaque qui intra venas grandiores coërcetur, quatuor illis succis perfunditur, sed ea proportionè vt in temperata et mediocri constitutione, purus sanguis multum antecellat, caeterisque praestet: ab hoc deinde pituita, quia dulcis est, potéstque in sanguinem conuerti, et compluribus partibus nutriendis est necessaria. Tertio loco est melancholicus succus: omnium autem paucissima est flaua bilis, tum ob nunc commemoratas rationes, tum etiam quòd illius quàm bilis receptaculum capacius et plenius deprehenditur in nobis, quòdque ex venae sectione, si sanguis asseruetur, plus subsideat lutulenti, quàm per summum innatet biliosi. Ea quidem est quatuor succorum in sanguine permistio. Caeterùm id nondum satis liquet, sínne ij veri humores, et quales in suis conceptaculis puros esse intelligentia sensuque comprehendimus, ánve ad illorum duntaxat speciem atque similitudinem accedunt. Magna quidem et controuersiae plena disputatio, quòd difficilè sit intelligere, vt humores puri ac veri consistant in venis. Etenim quae (verbi gratia) propriè verèque bilis dicitur, vsquequaque lutea est et prorsus amara, ad corpus nutriendum neutiquam habilis et accommodata, nimirum quae ne propriae quidem vesiculae, à qua ingenti sensus voluptate allicitur, alimentum sit. Eius quippe substantia supra omnem sanguinis est mediocritatem, atque adeò à nutriendi benignitate desciiuit, vt nulla caloris efficientia, nulla concoctionis praestantia vnquam possit in familiarem atque alimentariam reduci. Nec est quod dicat quispiam,

outdoes the rest, according to which they wish the whole blood to be described as [P131] phlegmatic, or bilious, or melancholic. Finally, they hold that exactly the same system applies to milk, because it consists in just three substances, with no fourth additional one to be described as “milk”; the whole that consists of these three suitably tempered takes the name of milk for itself.

But if we turn our eyes and mind closely to the parts of chyle, and view them in the light of their substance and combinations of qualities, not just three but four different kinds of them will turn up, from which four juices too will emerge. Further, if we assess the diversity of the parts of the body that these are to nourish, some will present themselves to which the three remaining humors can be related, and some too will be found likewise that are hot and wet like flesh, some temperate like skin, neither of which can be nourished except by quite pure blood. It is therefore absolutely necessary that in addition to the three remaining humors, pure blood too should be in the veins, and it far and away excels the rest. So the comparison of blood with milk must be regarded as inappropriate and ill-matched; and when blood decays, its whole substance does not depart into yellow and black bile, but a part is left too that either is undecayed or displays the form of decayed blood. And so blood confined within the larger veins is pervaded with these four juices, but in such proportion that in a temperate and intermediate constitution pure blood greatly predominates, and excels the rest; next comes phlegm, because it is sweet and convertible into blood, and required for the nutrition of several parts. Melancholic juice takes the third place; scarcest of all is yellow bile, both for reasons that have now been recounted, and also because a more roomy and full reservoir for melancholic juice [the spleen, presumably] is found in us than for bile, and because from blood kept after venesection more murky matter sinks to the bottom than bilious matter floats to the top. This is the mixture of the four juices in blood.

But it is not yet sufficiently clear whether these are real humors, of the sort that we can grasp with intellect and senses as being pure in their reservoirs, or whether they just approach the form and likeness of such. The argument is great and heated, because it is hard to grasp how pure and true humors exist in the veins. For example, what is properly and correctly called bile is everywhere yellow and thoroughly bitter, in no way ready and suitable for nourishing the body, presumably not being nutriment even for its own bladder, by which it is attracted with a great agreeable sensation. For its substance is above the mid-point of blood, and was so much of a renegade from the kindness of nourishing that no effectiveness of heat nor superiority of concoction can ever bring it back to be a congenial nourishing thing. Nor is it possible, as someone may say, that

non hanc synceram et puram, sed sanguini permistam corpus nutrire. Si enim omni substantia totóque genere alimenti rationem excessit, quoquomodo benigniorum temperatione perfundatur, integram omnino pristinámque naturam reseruabit, atque benigniora fortassis in corporis substantiam facessent, illa certè nunquam, quemadmodum neque lapidis aut ferri pulvis tenuissimus, quamquam cum pane est accuratè subactus, nutriendi vires consequitur. Quocirca bilis ea quam in sanguine atque in venis teneri fatemur, vera haudquaquam est, neque eius similitudinem speciémque gerit quae in folliculum reconditur, maximè si integrè sanum est corpus. Hoc et sensu comprobamus, nullam animantium partem (sed ne pulmonem quidem, quem tamen vnum prae caeteris ea nutrirí asseuerant) commanducatam bilis amarorem referre. Quin et totus sanguis dulcis est in sanis, qui tamen si amara bile perfunderetur, eius sapore inficeretur, quemadmodum si fellis tantulum lactis copiae iniicias. Praeterea vera bilis si cum sanguine in corpus perferatur vt in ictero, corpus flauo defoedat colore, nil autem tale sanis accidit. Íisdem propè rationibus demonstrari potest, nec atram bilem, nec superuacaneam pituitam fieri posse conueniens vsquam corporis alimentum. Ex quibus intelligitur quatuor humores, qui in sanorum sanguine continentur, synceros non esse, nec eorum naturam exprimere, qui in bilis folliculum atque in lienem coniecti sunt. At nihilominus ab aestu, ab exercitatione, à balneis, à calidiorum causarum vehementiori occursatione, non ambigimus partem sanguinis tenuissimam in flauam bilem eámque amaram conuerti, quemadmodum et reliquas sanguinis partes persistente similium causarum impetu, in affinem sibi [P₁₃₂] et finitimum humorem. Idem propè accidit, et quum ex vehementi obstructione orta putredo, sanguinis molem inuaserit. His ergo ex causis praeter naturam alij humores à sanguine gignuntur in venis. Quinetiam plerunque in has permeant ex aliarum partium vitio: bilis quidem flaua quum iecur immodico calore flagrat, aut quum vesicula fellis velut in ictero intercluditur: melancholicus succus quum lien vel obstructus, vel quauis ex causa imbecillior factus, non potest sanguinis limum prolicere: pituita quum ob frigidiorē intemperiem ingens oboritur cruditas tum ventriculi, tum iecoris, vt in leucophlegmatia. Ab his igitur causis puri atque vitiosi humores in venis sanguini permiscuntur, è quibus illos demum cernimus per multa morborum genera foras subter cutem erumpere. Caeterum corpus quod omnino sanum et integrum est, quacunque etiam id temperie naturaliter sit affectum, si nec alimentorum vitio, nec aliis externarum causarum iniuriis lacessitur, puros atque synceros humores nullos habet in venis sanguini

in pure form it does not nourish the body, but does when mixed with blood; if it has exceeded the role of food with all its substance and the whole of its kind, in whatever possible way it may be pervaded with the temperament of more congenial things, it will preserve its entirely intact original nature; perhaps more congenial things will get into the substance of the body, but certainly never this one, just as the most finely milled powder of stone or iron, even though carefully ground up with bread, acquires no powers to nourish. Therefore, the bile that we hold is present in the blood and veins is not genuine at all, and does not present the likeness and form of the bile stored in the gallbladder, especially if the body is in perfect health. We confirm by our senses that no part of animals when chewed up produces the chewed-up bitterness of bile, not even the lung, which, alone among the others, people say is nourished by bile. Further, in the healthy all of the blood is sweet, yet if it were imbued with bitter bile, it would be impregnated with its taste, as happens if you add a little bile to a quantity of milk. In addition, if genuine bile is carried into the body with the blood, as in jaundice, it sullies the body with a yellow color, but nothing of the sort happens in the healthy. On practically the same evidence it can be shown that neither black bile nor superfluous phlegm can become suitable nutriment for the body anywhere. It follows that the four humors present in the blood of the healthy are not pure, and that those concentrated in the gallbladder and spleen do not develop their nature. However, we have no doubt that hot weather, exercise, baths, and the more violent onslaught of hotter causes make the most rarefied part of the blood change into yellow bile (and it is bitter too), just as the remaining parts of the blood change into humor [Pr32] akin to them, on the impact of similar causes. Nearly the same thing happens too when putrefaction produced by a severe obstruction has invaded the mass of blood. So from these preternatural causes other humors are generated from blood in the veins. Further, they often make their way into the veins through a fault in other parts: yellow bile when the liver blazes with excessive heat, or when the gallbladder is cut off, as in jaundice; black bile when the spleen is either obstructed, or weakened from any cause, and cannot coax out the blood's silt; phlegm when, through a colder failing of temperament, a huge lack of digestion comes on in both stomach and liver, as in the veins in leucophlegmasia. So these are the causes why pure and faulty humors are mingled with blood, and we finally see them bursting out from the veins under the skin, in many kinds of disease.

But a body that is entirely in sound health, and also under the natural influence of any temperament, provided it is not being challenged by faulty foods or the insults of outside causes, has no pure humors mixed with the blood

permistos, sed eo duntaxat modo quem nunc exposui. Videríne potest Hippocrates his contrarium attulisse? Libro quem de humana natura conscripsit, hominem ait quoad vita fruitur omnia in se continere, sanguinem, pituitam, et vtramque bilem. Epoto enim medicamento quod pituitae educendae sit idoneum, pituita euometur: eo autem quod bilem flauam purgat, bilis: eo quod atram elicere natum est, atra bilis purgabitur: sin vulnus acceptum fuerit, sanguis profluet. Haec autem accidere compertum est quouis die ac nocte, hyeme et aestate. Verè quidem haec sunt ab Hippocrate pronuntiata, veruntamen quae ex corpore non è venis necessario, sed aliunde etiam detrahuntur, bilis quippe ex hepate et è proprio folliculo, pituita (si vera pituita dici ea debet) è ventriculo et intestinis, melancholicus humor è liene, in quibus locis solet eorum humorum aut potius excrementorum copia affluere. His etiam qui incorrupta sanitate sunt, idcirco difficiles fieri censuit purgationes, quòd quum desint affines et cognati quos medicamentum trahat humores, sanguinem id et carnes colliquefacit, quò ex his proprium alliciat humorem. Quibus quidem verbis significat, sana corpora cum sanguine reliquos humores in venis reuera non habere, sed potestate duntaxat: quia fieri potest, vt medicamenti, aut aliarum quas dixi causarum vis et vehementia, ex variis partibus sanguinis, varios excitet et proliciat. Hinc iam constitui possunt et explanari sanguinis naturalis differentiae, quòd alius substantia sit mediocri et colore ruber, qui pulcherrimus et optimus appellatur: alius magis flauus et consistentia tenuis, alius crassior atque nigrior, alius demum liquidior et albior. Quum autem à pristina natura desciscens, vitio corrupteláque deprauatur, et è limitibus iam excessit, non naturalis appellatur. Excedit autem bifariam, aliàs paululum ob leuem modicámque intemperiem substantiae mutationem, nulla ex parte in aliud humoris genus conuersus: hic quidem etiam tum sanguis est, tamen naturalis minimè: aliàs multum, quum vel proprio contaminatur vitio, vel alieno perfunditur humore, atque hic non simplex, sed ex multis permistus est humoribus. Haec de sanguine, nunc ad caeterorum humorum differentias pergamus.

Pituitae et vtriusque bilis differentiae. Cap. IX.

HUMORIS QUIDEM appellatio quanquam propriè Latinis qualitatem duntaxat eam designat, quae Graecis est ὑγρότης, medici tamen ad omnem etiam profluentem et liquidam substantiam

in its veins, except only in the way I have now set forth. Can Hippocrates seem to have contributed the opposite of this? In the book he wrote about human nature, he says that throughout a man's enjoyment of life, he has them all in him: blood, phlegm, and both biles. After the swallowing of a medicament suitable for drawing out phlegm, phlegm will be vomited up; after one that clears yellow bile, bile; after one produced to extract black bile, black bile will be expelled; or if a wound has been sustained, blood will run out. These events are noted any day and night, winter and summer. They were truly declared by Hippocrates, but what is drawn out of the body does not necessarily come from the veins, but also from elsewhere, namely bile from the liver and from its own bladder, phlegm (if it is to be called real phlegm) from the stomach and intestines, melancholic humor from the spleen, the places in which a supply of these humors (or rather waste matters) generally abounds. In people of unimpaired health, he considered that purgings grow difficult because, when there is a lack of the kindred humors for the medicament to extract, it dissolves the blood and the flesh, so as to coax out its own humor from them. These words of his mean that healthy bodies do not hold the other humors along with the blood within the veins in reality, but only in potentiality, because what can happen is that the power and violence of the medicament, or of the other causes I mentioned, stirs up and lures out various humors from various parts of the blood. From this the distinctions of natural blood can now be established and expounded, because one blood may be of middling substance and red color, and is referred to as the choicest and best. Another is yellower and of thin consistency, another is thicker and darker, yet another more liquid and whiter. But when it departs from its original nature and is perverted by defect and corruption, and has now left its boundaries, it is referred to as unnatural. It departs in two ways: sometimes a little, through a slight defect of temperament or change of substance, without conversion in any part to another kind of humor. This too is blood at the time, but barely natural. At other times it departs a great deal, when either contaminated by a defect of its own, or pervaded by a humor from elsewhere, and is then not simple, but mingled from many humors. So much for blood; now let us proceed to the different sorts of the other humors.

*Chapter 9. The different sorts of phlegm
and of the two kinds of bile.*

IN CORRECT Latin the name "humor" is used to indicate just a quality, which in Greek is *hygrotes*, but physicians apply this name also to every liquid substance,

hoc nominis accommodant, vt id sit humor, quod etiam Graeci ὑγρὸν propriè dicunt: quicquid in corpore profluens liquidúmque cernitur, siue id chylus est, siue mucus, siue sputum, siue vrina, siue sudor, siue sanguis, siue pituita, siue bilis tum flaua tum atra. At quum genus hoc omne in species diuidendum distribuendúmque erit, percensebuntur quidem humorum alij toto genere superuacanei (hos suprà vniuerso excrementorum genere sumus complexi) alij verò ad nutriendum et corpus sustentandum apti. Horum autem genus duplex, chylus et chymus, ille fortassis cremor, hic succus rectè nobis appellabitur. Est quidem chylus in ventriculo: at succus in iecore ortus, et ad corporis nutritionem praeparatus. Succorum autem alij primi sunt et praegredientes, alij secundarij et consequentes, quorum iam antè rationem [P133] breuiter explicauimus. Primi succi quatuor numerantur, sanguis, pituita, et bilis, tum atra, tum flaua: hi enim singuli quemadmodum et secundarij, constitutionem acceperunt ad corpus alendum, licet id quandoque non praestent, neque praescripto fine potiantur. Itaque succorum alius naturalis, qui et omnino vtilis est, alius non naturalis, qui non satis probè alere potest. Similiter excrementorum aliud naturale, quod in corpore optimè sano naturae legibus prouenit, aliud praeter naturam. Naturale aliud vtile, quod vsum quempiam confert in corpore, vt bilis in vesicula, et quae in liene est melancholia, aliud prorsus inutile, vt fex alui, vrina vesicae atque sudor. Non naturale est, quod citra naturae praescriptum à causis praeter naturam gigni solet. Itaque tum pituita, tum vtraque bilis triplex est omnino, alia ad nutriendum apta quae alimentaria dicitur, alia superuacanea, quae aut naturalis est, aut praeter naturam. Bilis alimentaria est sanguinis pars tenuissima, per venas distributa, tum vt affines naturae suae particulas nutritur et alat, tum vt reliquo sanguini qui prae crassitudine, non sine multo negotio, per venas perlaberetur, transuectionis promptitudinem afferat: quod quum praestiterit, siquid minus vtile restet ac superfluat, id vnà cum sudoribus defluit et foras erumpit. Superuacanea è sanguine tanquam excrementum in bilis vesiculam amandatur, proprio deinde ductu in intestina illabens, tum ea ad excrementorum deiectionem stimulat, vnde et fuluo colore infecta comparent, tum lentam et adhaerentem illis pituitam detergit et exturbat, quae alioqui immodicè aucta, in grauissima incommoda deduceret. Ea ferè flaua existit et mediocritatem quandam tum substantiae tum caloris obtinet: ex qua tenuis cuiusdam humoris permistione, altera procreatur colore pallidior et substantia tenuior, vtraque licet superuacua sit, naturalis tamen est et naturae legibus continetur in nobis.

so that it is a humor, which Greek too correctly calls *hygron*: any liquid seen in the body, whether chyle or mucus or sputum or urine or sweat or blood or phlegm or bile both yellow and black. But when this kind is all to be divided up into forms ["species"], some in the whole kind of humors will be reckoned redundant (we included them above in the complete kind of waste matters), but others reckoned suitable for bodily nutrition and support. The latter are of two kinds: chyle and chyme; we shall perhaps be right to call chyle the cream and chyme the juice. Chyle is certainly in the stomach, but juice had its origin in the liver, and is ready for the body's nutrition. Some of the juices are primary and in the lead, others are secondary and follow, and we have already given a brief [P133] account of them previously. The primary juices are four in number: blood, phlegm, and bile both black and yellow; individually, like the secondary ones, they have acquired a disposition for nourishing the body, although sometimes they may not provide this, or attain their appointed target. And so one of the juices is natural, and entirely useful; another is not natural, and cannot nourish well enough. In the same way one of the waste matters is natural, because it appears in an ideally healthy body in accord with nature's conditions, and another is preternatural. The natural one is useful, because it contributes some benefit in the body, like bile in the gallbladder, melancholy in the spleen; the other is totally useless, like the feces ["fex"] of the rectum, urine of the bladder, and sweat. It is unnatural, because it usually comes into existence outside the ordinance of nature, from preternatural causes. And so phlegm and both [sorts of] bile are threefold in all: one suitable for nutrition and called alimentary, another redundant, which is either natural or preternatural. Alimentary bile is the most rarefied part of blood, dispersed along the veins, both to nourish the parts akin to its own nature, and to bring speedy transport to the rest of the blood that because of its thickness was flowing through the veins with a great deal of difficulty. When it has brought it,¹⁷ anything of less use that is leftover and surplus runs off along with the sweats and breaks out externally. Redundant [bile] is relegated from the blood as waste matter into the gallbladder, and then gliding through its own duct into the intestines, spurs them on to eject wastes, which is why they are found to be tinged with a yellow color; and then it wipes away and expels the viscous phlegm adhering to them, which would otherwise build up excessively and lead to very serious harm. Bile is generally yellow, and possesses an intermediate degree of both substance and heat; out of that, through the admixture of some moisture [humor], another bile is generated, paler in color and thinner in substance; though either sort may be redundant, it is still natural, and its presence in us accords with nature's laws.

Gignitur et interdum bilis praeter naturam, genere quadruplex. Vna est vitellina, Graecis λεκιθοειδής appellata, quam flaua à naturae modo deficiens profert, dum caloris non naturalis acrimonia torretur, vt ex fuluo igneum colorem, et ex tenui substantia crassiorem dissipatione consequatur, quae et colore et crassitudine omnino vitellorum crudorum ouorum speciem offerat, à quibus nomen sibi asciuit. Auerrhois rectè mihi videtur Auicennam erroris insimulasse, qui vt multa alia peccat, in vitellinae opinione turpissimè labitur, contendens nimirum hanc fieri, dum pituitae aut melancholiae portio flauae bili permiscetur. Hinc in bile egregia illa comminiscitur maioris et minoris famae genera, quae quàm plurimos in designandis febrium differentiis, mirificè ne dicam ridiculè implicatos et circunretitos tenent. Hac enim opinione vitellinam bilem frigidiorem redderet flaua et naturali, quam tamen multis partibus ardentiorum esse inter omnes constat. Adde quòd simplicium humorum differentias dinumeraturus, quasi inconstans aut certè iam sui immemor, ex eorum permissione noua quaedam et inaudita simplicium genera inuehere conatur. Quas tres hactenus commemorauimus bilis differentias, omnes in iecore generantur atque in vasis. Praeter has autem aliarum par numerus recensetur, quae saepius à praecordiis originem habent: vna est porracea Graecis πρασοειδής, altera aeruginis similitudine ιώδης dicta, tertia ισατώδης glauco aut ceruleo colore glastum referens. Harum gignendarum esculenta quaedam vitiosa et mali succi non modò occasio, sed etiam causa fiunt, cuius generis censentur allium, porrum, caepa, nasturtium, et sinapi, maximè eorum folia. Dum enim nequeunt à ventre deuinci, neque in chylum conuerti, ac colorem suum magna ex parte retinent, primùm ex illis fit porracea, quae si infixa diutius haereat et commoretur, persistente ventris incendio, in aeruginosam commutabitur: haec demum in eam quae glasti colore tincta apparet, minus quidem viridis quàm superiores, sed tantò illis deterior, quantò propius ad nigrum colorem accedit. Gignuntur et haec genera nonnunquam in venis ac iocinere, idque per morbos graues et ardentissimos, qui vehementi caloris incendio bilem vitellinam exurunt, et in haec genera deducunt prorsus pernitiola quidem et exitialia. Ex his demum summè vstis fit et in conspectum se dat atra bilis ea, quae omnium est humorum deterrima. Melancholiae autem multae sunt differentiae, vna quidem qualitatibus mitior, quae cum sanguine in venas peruadens corpori [P134] alendo est idonea. Hanc medicorum praecipui visi sunt μέλανα καλεῖν χυμὸν,

Sometimes, too, preternatural bile is produced, fourfold in kind. One is the “egg yolk” type (“*lecithoeides*” in Greek), brought into existence by yellow bile falling short of the natural level during roasting by the fierceness of unnatural heat, so as to take on a fiery color replacing brown, and a substance thicker through dispersal, replacing the thinner one, and in both color and thickness entirely presenting the form of yolks of raw eggs; hence its name. Averroes seems to me right to have accused Avicenna of error; Avicenna makes many other mistakes, and his view of the “egg yolk” type is a shocking slip; he evidently maintains that it comes about when a portion of phlegm or melancholy is mixed with yellow bile. Hence in bile he invents those extraordinary kinds [“genera”] enjoying greater and less repute, which keep very many people who are engaged in stating the differences between fevers marvelously (indeed absurdly) enmeshed. Following this line, he would make “egg yolk” bile colder than natural yellow bile, though everyone agrees that in many parts it is hotter. What is more, in setting out to enumerate the distinctions of the simple humors, he seems fickle, or anyway absentminded, and tries to introduce, from a mixture of them, unprecedented kinds of simple ones.

The three different kinds of bile we have so far described are all generated in the liver and the vessels. Besides them, an equal number of other ones is included, which have their origin quite often from the rib cage: one is leeklike (in Greek, *prasoeides*), another is called *iodes* [rustlike] from its resemblance to *verdigris*, and the third *isatodes* [woadlike] for suggesting woad by its gray-green or blue color. Faulty food and bad juices become not only the opportunity but also the cause of their development, and garlic, leek, onion, cress, and mustard, especially their leaves, are reckoned to be of the kind. During the time that they cannot be overcome by the stomach, nor changed into chyle, and keep their color for the most part, first of all leeklike bile is made from them; and if it settles longer stuck there, with the belly’s fire continuing, it will be changed into the *verdigris*-like one, and that finally into the one that looks tinged with the color of woad, less green than its predecessors, but worse than them the nearer it gets to a black color. Sometimes too these kinds are generated in the veins and liver, during serious and very hot diseases, which burn out the “egg yolk” bile through the violent blaze of their heat, and bring down total disaster and destruction on these kinds. Ultimately, from their complete combustion there emerges visibly the black bile that is of all humors the worst. There are many different kinds of melancholy: one more mild in qualities, which penetrates with the blood into the [P134] veins and is suitable for bodily nutrition. Distinguished physicians have thought fit to call this black chyme (black juice),

οὐ μέλαιναν χολήν id est atrum vocare succum, non atram bilem. Sicuti plerunque melancholicum succum vel melancholicum sanguinem, non atram bilem. Superuacanea est, quam lien sanguinem expurgans, è iecore prolicit et in se recondit. Haec quemadmodum et quae in folliculo est bilis, sanguinis quidem non autem corporis excrementum est, quippe quae et lieni et ventriculo non mediocriter conducat. Quocirca naturalis est, et nondum atra bilis, sed ater humor nuncupari debet. Quantum verò huius vel exustione, vel non naturalis caloris vi putrescens, acidam aut acerbam qualitatem aut acrimoniam contraxit (idem enim putredo quod vehemens incendium solet efficere) id quasi in cinerem conuersum, conuenit atram bilem nuncupare, quae omnino praeter naturam sit. Est autem ea triplex, vna ex melancholico succo vel humore profertur, quae aut putredinis aut caloris ardore quasi in cinerem conuertitur. Haec calida quidem, est acris et mordax, eo discrimine à superuacua naturali dissidens, quo sex vsta ab non vsta. Quem dico cinerem non ei parem existimo, qui exustis lignis manet, haudquaquam enim possunt humores omni suo liquore spoliari: sed ita summam dico humorum siccitatem et quantam maximam possunt in corpore ardoris vi consequi. Altera species ex ea fit bile quam vitellinam dixerunt. Exustione enim haec primùm in porraceam, deinde in aeruginosam, pòst in ceruleam, nouissimè in atram omnium perniciosissimam commigrat, quae tantò certè deprehenditur malignior, quantò bilis melancholia est acrior. Ea enim est quae in terram impacta, fermenti more et quodam quasi aestu efferuescens, hanc iactat et excutit: quae sua crassitudine parti se affigens adhaerescénsque, eam arrodit et exulcerat: quae demum in perniciem semper excernitur: quanquam horum omnium vitiorum altera etiam quodammodo particeps est. Ex sanguine nulla proximè bilis atra profertur. Nam si sanguinem statuamus vel incendio vel putredine in venis torreri et conflagrare, prius quidem necessariò pars eius in bilem flauam, pars in melancholiam migrabit, ex quibus deinde non aliae quàm duae commemoratae fieri poterunt atrae bilis differentiae. Quum autem sanguis è venis illapsus fuerit in ventrem, in intestina, aut in aliam interiorem capacitatem, illic quidem primùm concrescit in grumos, tandèmq̃ putrescit. Excernitur is plerunque liquidæ picis modo nigerrimus, summè malignam, ac ferè venenatam qualitatem adeptus: hic tamen tum nomine, tum re ipsa ab atra bile differt, quandoquidem extra venas à se discedens non in alios conuertitur humores, sed totus concrescens humor esse desiit, nec tum humor dici potest, sed corruptus grumus. Neque ex pituita dulci fit bilis atra. Nam quae ex cerebro stillat, aut quae in pulmonibus, in ventriculo, aut intestinis coaceruatur, vehementi

not black bile. Similarly, often melancholic juice or melancholic blood, not black bile. It is redundant, and the spleen, in clearing the blood of it, coaxes it out of the liver and stores it away. Like the bile in the gallbladder too, it is waste matter of the blood but not of the body, since it is of considerable advantage to both spleen and stomach. So it is natural, and must not still be called black bile, but black humor. There is a quantity of it that decays, either through being burnt up or through the power of unnatural heat, and has taken on an acid or bitter quality or corrosiveness (the same decay that a fierce fire normally produces); this quantity, changed (so to speak) to ash, is appropriately called black bile, which is altogether preternatural. It is of three kinds: one is derived from melancholic juice or humor, which the warmth of decay or of heat turns (so to speak) to ash. This is indeed hot, and is sharp and stinging, distinguishable from natural redundant [melancholic juice] by the same criterion that separates the six burnt [sorts] from the unburnt ones. What I call ash is not, I think, the same as what remains when logs are burned, for humors cannot possibly be deprived of all their liquid; I mean the utmost dryness of humors, the most they can attain in the body from the power of heat.

Another species develops from the so-called “egg yolk” bile. On burning up, this removes first to the leeklike type, then to the verdigris-covered, later to the blue, lastly to the black, the most destructive of all; it surely turns out as much more harmful, as bile is bitterer than melancholy. It is this that fizzes like yeast with a sort of boiling when it strikes the earth, and tosses and scatters it. Attaching itself to a part by its thick consistency, it corrodes and ulcerates it. Lastly, its excretion is always fatal, despite the other one being a sharer too in all these defects, after a fashion.

No black bile is produced directly from blood. If we judge that blood is being baked and burnt up in the veins by fire or decay, inevitably first some will remove into yellow bile and some into melancholy, from which then no other different kinds of black bile can arise than the two described. But when blood has glided out of the veins into the belly, the intestines, or some other internal cavity, it starts by congealing there into clots, and ends by decaying. On separation it is mostly like liquid pitch, very black, extremely harmful, and with a practically poisonous quality; however, it differs from black bile both in name and in reality, since on parting company from itself outside the veins it is not altered into other humors; instead, it clotted as a whole and stopped being a humor, and then could be called not a humor, but decayed gore.

Black bile does not come from sweet phlegm either. What drips from the brain or accumulates in the lungs, stomach, or intestines hardens on strong

calore durescit, vt mox erit manifestius, nunquam in alterius humoris speciem mutatur: quare neque potest ex ea atra bilis suscitari. At verò pituita falsa quoniam caloris cuiusdam praeter naturam est particeps, si vehementius et prorsus torreatur, acrem, atrámque bilem gignit, quae tertia species est, vnde intelligi potest non omnem atram bilem ex melancholico aut bilioso humore nasci. Porro autem pituita quae verè et propriè dici meretur, succus est alimentarius, totiúsque sanguinis portio crudior, quae et sanguis ex dimidio coctus appellari solet. Permanat haec in venas, tum vt partes frigidas et humidas, cuiusmodi est cerebrum, alat: tum vt si aliquando penuria erit sanguinis, in eum conuersa reliquis etiam partibus in alimentum cedat. Neque verò vt sanguinis forma plenè exornetur, necesse est in iecur ea recurat, sed venae ipsae ad id operis perficiendum, satis virium et caloris obtinent. Caeterum neutra bilis potest vlla vi in sanguinis mediocritatem et benignitatem reduci. Licet enim quandoque adeò refrigeretur, vt fortasse qualitatum mediocritatem assequatur, non potest tamen substantiae benignitatem recipere. Atque haec quidem alimentaria pituita dulcis existit. Ex qua aliae duae praeter naturam emergunt. Vna est quae acida vocatur, summè quidem cruda, et quae praeter primam ventriculi confectionem, vix vllam aut minimam in iecore atque venis accepit. Paucus admodum calor ei inest qui perfacilè dissipatur et euanesceat, atque tum pituita necessitate quadam coacescit. Par enim atque vna ratio est ac in plerisque fructuum succis, qui si non multo praediti [P135] sunt nativo calore, posteaquam sponte sua efferbuerint, mox in breui coacescunt: quibus autem valentior impertitus est calor à natura, ij vt vinum generosum, diutius in integritate sua persistunt. Altera pituitae species salsa appellatur, ex dulci haec putrescente nata: quum enim portiones eius quaedam vi putredinis assae, reliquae dulci substantiae permiscebuntur, falsum hunc saporem inducent, quod et in maris aqua fieri demonstrant. Tres hae pituitae species consistunt in venis, prima quidem naturalis, reliquae duae praeter naturam: quarum omnium materia à iecore sumpta est et initium duxit, qualitas autem aliunde irrepsit à causis quae contra naturam sunt. Superuacua pituita extra venas consistit, cuius sunt differentiae quatuor. Vna est pituita tenuis et aquea, qualis plerunque aquae modo stillat è naribus, aut è cerebro in plurimas corporis partes illabatur. Altera censetur muco similis, quam corporis calor ex illa tenui ob modicum lentorem cuius particeps est, ad muci consistentiam coëgit. Haec si caloris vi et appulsu tantam adipiscatur crassitudinem, vt iam partibus conclusa possit adhaerescere, vitrea tum appellabitur, quae tertium genus est. Ad extremum verò cùm ex concrezione sic iam durescet,

heating, as will soon be quite clear, and never changes into the form of another humor; consequently black bile cannot be derived from it either. But as false phlegm has preternaturally a share of some heat, if it is more violently and thoroughly baked it gives rise to a bitter black bile, which is a third form, and so it follows that not all black bile is derived from melancholic or bilious humor. Further, phlegm really and properly deserving the name is an alimentary juice, and the less digested portion of whole blood, which is commonly also called half-concocted blood. It percolates into the veins, both to nourish the cold moist parts such as brain, and, if there is ever a lack of blood, to change into it and serve as nutriment for the rest of the parts. To be fully adorned with the form of blood, it does not have to return into the liver; the veins themselves possess enough powers and heat to complete this task. But neither of the biles can be brought back by any power to the midpoint and bounty of blood. Even though sometimes it is chilled so far that it perhaps reaches the midpoint of qualities, it still cannot acquire the bounty of substance. And this alimentary phlegm is sweet. From it two preternatural phlegms emanate. One is called acid: extremely undigested, and apart from the first preparation in the stomach, it received hardly any, or very little, in the liver and veins. The heat in it is quite scanty; it very easily disperses and vanishes, and then the phlegm is obliged to turn sour. A single comparable pattern is present in most fruit juices too: if they do not have much [P135] native heat, then when they have fermented spontaneously, they quickly sour. But those to which nature has imparted stronger heat are like wine of character, and stay longer intact. The other form of phlegm is called the salty, and emanates from the sweet as it decays. When some portions of it are dry from the power of decay, and get mixed with the remaining sweet substance, they will bring on this bogus flavor, as is shown to happen in sea water too. These three forms of phlegm are present in the veins, the first a natural one, the other two preternatural; the material of all of them is drawn and took its origin from the liver, but the quality has stolen in from elsewhere, through causes that are against nature.

Redundant phlegm exists outside the veins; there are four kinds of it. One is thin watery phlegm, the sort that commonly drips like water from the nostrils, or slips from the brain into very many bodily parts. Another is reckoned as like mucus; the body's heat started from that thin phlegm, thin because of the modest amount of stickiness in which it has a share, and condensed it to the consistency of mucus. If this acquires such thickness from the impact of heat that it can stick to the parts enveloping it, then it will be called glassy, which is a third kind. In the end, when it has grown so hard from solidification as closely

vt à lapidis aut gypsi duritia non procul absit, quarta tum emerget quam multi gypseam appellant. Hanc saepe deprehendimus in pulmonibus et in digitorum articulis, accepto quidem ex distillatione principio, tandem in extremam tophi et calculi duritiem euasisse. Ea certè omnis est atque integra humorum explicatio, ex qua liceat cognoscere qui ab excrementis, quive à venarum succis, ortus sui primordia acceperint, nunc de animalibus functionibus transigendum nobis est.

De animalibus functionibus. Cap. X.

QUEMADMODUM ALTRIX illa, quin potius tota naturalis pars animae in vnum corporis alimentum prorsus incumbit, suásque omnes in id gestiones confert: sic altera pars animae quae sentiens est et appellatur, in iis rebus externis versatur, quae circuniectae sunt nobis, totaque negotiatur vt illarum cognitionem capiat, suisque ministris et nuntiis sensibus rerum omnium notiones in se comprehendat. Haec illius molitio, haec agitatio, qua assidue concitatur et impellitur, quae qua ratione obiri perficique solet, verbis explicare conabimur. Sentiens anima quemcunque illa substantiae modum est adepta, cerebri corpus tanquam propriam arcem ingenitumque domicilium elegit, omnium quas dixi facultatum vires in se suoque quasi sinu complexa. Has quidem propriis quibusdam functionibus et muniis exponit, ad quas varia instrumenta confert et accommodat. Omnium primum spiritus est animalis appellatus, qui ex vitali per ceruicis arterias in contextum admirabilem sublato, primum elaboratur, deinde in interiore altero cerebri contextu, qui à secundis nomen habet, vi cerebri ingenita in animale conuertitur. Illic nova specie et dignitate praequalgens, sentientis animae vires consequitur, et ad illius cuncta munia illo se splendore aptat et comparat. Hoc plurimo conferti sunt ventriculi, interiorésque cerebri sinus, vnde tanquam è iugi fonte per neruorum ductus et canaliculos, tum in sensuum instrumenta, tum in musculos motores profluit. Hic autem quum iam insidet, aliam fortassis speciem ex partis natura suscipit, qua particulatim illi addicta est, eiusque seruitio prorsus mancipatur. Quòd si est, non vnus idemque fuerit videndi, audiendi, odorandi, gustandi, atque tangendi spiritus, quinetiam ab illis longius distabit qui motioni destinatus est. Alterum instrumenti genus ex crassiore magisque terreno corpore constat, vt in quo tum spiritus ille, tum externarum rerum imagines conceptae seruari debent. Non vna id eademque vbique substantia praeditum,

to resemble the hardness of stone or plaster of Paris, the fourth kind will turn up, which many people refer to as like plaster of Paris. In the lungs and the finger joints, we often find that this has originated from catarrh, and finally attained the extreme hardness of tophus and calculi.

This is surely a comprehensive account of the humors, from which one can learn which of them took the origins of their development from waste matters, or which from venous juices; now we must move on to animal functions.

Chapter 10. Animal functions.

THE NURTURING part already mentioned [*“illa”*], and furthermore, the whole natural part of the soul applies itself altogether to bodily nutriment only, devoting all its activity to that. In the same way the other part of the soul, which is called the sentient part, concerns itself with our external surroundings, and is wholly occupied with acquiring knowledge of them, getting hold of concepts of everything with the aid of its messengers, the senses. This effort it makes, this pursuit that constantly urges it on: we will attempt to explain in words the basis on which it usually sets about these. Whatever type of substance the sentient soul has acquired, it has selected the body of the brain as its own stronghold and inborn dwelling, clasping to itself and (so to speak) to its bosom the powers of all the faculties I have mentioned. It makes these available for certain functions of its own, to which it applies and adapts various instruments. The first of them all is called animal spirit, developed initially from vital spirit conveyed up through the cervical arteries into the *rete mirabile*; then in the other internal cerebral structure, which has its name from the afterbirth,¹⁸ the innate power of the brain turns it into animal spirit. There, in the glory of a new form and status, it takes on the powers of sentient soul, for all of whose functions it gathers itself with famous brilliance. The ventricles and inner chambers of the brain abound with a great quantity of this, and from them it flows forth, as from a running spring, through the nervous channels, then into the sensory instruments, then into the motor muscles. While it is located here, it may take on another form, a form by which it is bound in detail to the part, and entirely made over to its service.

If this is so, then the spirit of seeing, hearing, smelling, tasting, and touching will not be one and the same, and even more different will be the one allocated to movement. There is another kind of instrument, made from a thicker and more earthy body, and it is in it that this spirit, and also the perceived images of external things, must be kept. This instrument is not endowed everywhere with

neque vnusmodi, sed multiplex et varium. Interiorum motionum cerebri corpus instrumentum est, quod varia et multiplici sua conformatione ad omnes animi actiones agitationésque sese iungit et applicat, visioni verò oculus et qui ad hunc pertinent nerui, auris auditioni, orationi nares et cerebri papillae, gustatui lingua, tactioni tangentium neruorum propagines, vt motioni duriores et muscoli in quos illi se fundunt, ancillantur et ministrant. Varia haec sunt instrumenta corporea [P136] in hîsque spiritus siti dispares et varij: sic et facultates quae ab illis omnem agendi rationem acceperunt, neque quicquam possunt citra illorum opem praestare, non modica varietate distinctae sunt, tametsi omnium vna est eadémque substantia. Quae igitur sic comparata sunt organa, vt in subiecta conformataque materie familiarem quendam spiritum obtineant, in eoque spiritu facultatem, quae organi species est et ratio, ea quidem idonea fiunt et concinna suis muneribus obeundis. Quae qualiter compleri absoluíque possint, hoc iam contextu sigillatim aperiám. E sensibus externis alij contrectando munere suo funguntur, vt tactus et gustus, qui non nisi coniuncta sibi percipiunt, alij medij cuiusdam corporis interposito sentiunt, vt visus, vt auditus, et olfactus. Corpus autem id medium intercedens, aut aër est, aut aqua: vtrunque enim elementum ad inuersionem eorum quae sentiuntur idoneum est: nam colores et sonos per aërem percipiunt quaecunque terrenae gradiuntur aut serpunt animantes, per aquam verò aquatiles. Dura itaque et solida corpora, quum aut in aëre, aut in aqua inuicem colliduntur, sonum edunt ac strepitum, in hac quidem obscurum, in aëre verò perspicuum: maximè verò si illa leuia sint concaua et ampla, quae celeribus et magnis ictibus configant. Aër igitur qui inter dura corpora confertim et impetu in se incurrentia continetur, primùm sonitum efficit. Hic quidem non illinc abiungitur, vt ad auditum ipse accedat, sed proximum sibi et continuum aërem commouet, atque hic repente alium, donec successione continenter ad auditum motus perferatur: quo more in fluctibus cernitur alter alterum trudere, qui pulsus deinde sequentem impellit. Hinc accidit, vt non simul ac corporum allisio conflictúsque inciderit, sed aliquantò post ictum sonus audiatur, priúsque à propinquo quàm à longinquo. Sic exterior aër agitatus impulsúsque, per aurium tortuosos et flexuosos anfractus motu perplacido, citra vllam turbam fertur, peruadítque adusque interiorem illum aërem membrana obtensa conclusum, et auribus ingenitum. Huic autem membranae assidens, blandè eam ferit et concutit, vt ea agitatione tota strepat et personet. Externus aër tum demum cum interiore illo continuatur et adhaerescit, illiúsque interuentu audiendi spiritui, qui cum illo implicitus

one and the same substance, and is not of one sort, but manifold and diverse. The cerebral body is the instrument of internal movements, and by its manifold and diverse configuration applies itself to all the activities and pursuits of the mind ["animus"]: the eye and its related nerves meet the needs of vision, the ears those of hearing, the nose and cerebral nipples those of smelling, the tongue those of taste, the branches of the tactile nerves those of touch, and the harder nerve branches and the muscles to which they run, those of movement. These bodily instruments are diverse, and [P136] the spirits located in them different and various: similarly, the faculties that have received their whole basis of action from them, and can provide nothing without their aid, are separated by considerable diversity, although they all have one and the same substance. These instruments are constituted in such a way as to hold some congenial spirit in material that is subject and molded, and in this spirit a faculty, which is the form and pattern of the instrument; they become neatly suited to the performance of their tasks. How these can be brought to completion I shall now disclose in detail by this scheme. Of the external senses, some operate by contact, for instance touch and taste, which only perceive what is in contiguity with them. Others sense through the intervention of some body in between, as do sight, hearing, and smell. This intervening body is either air or water; either element is qualified to convey inward what is being sensed. For all animals that walk or crawl on the earth perceive colors and sounds through air, but aquatic creatures do so through water. And so, on striking each other in air or in water, hard and solid bodies emit a noisy sound, confused in water, but clear in air; and particularly if they are light, concave, and wide, so as to clash with large rapid impacts. Air, confined between hard bodies rushing violently into close contact, first creates the sound, which is not detached from there so as itself to reach hearing, but agitates the air next in contact with it, which instantly does the same to another, until the movement is conveyed in unbroken series to hearing. The same is seen in waves: one thrusting another, which when pushed presses on the next in line. This is why a sound is not heard just at the time the impact between the bodies has occurred, but somewhat later on, and sooner from an impact nearby than from a distant one. This is the way in which, when the external air is set in motion, it proceeds in a gentle movement through the winding bends of the ears without any commotion, and penetrates up to that internal air confined by the taut membrane and innate in the ears. Alighting on that membrane, it taps it persuasively, making it all ring with the displacement ["agitatio"]. The outside air ends up in continuity with this internal air, which by its mediation links it to the spirit of hearing, a spirit intimately associated

est, confertur: hoc demum exploratore et ministro recepta strepitus imago, ad sentiendi principium transmittitur. Sed haec apertiùs iudicabuntur aestimabunturque ex odorandi ratione. Nam cedrus, thus, aliique odores incensi calefactique suauem et iucundum odorem spirant, qui in arido quasi fumo situs est. Hic sensim tanquam vapor per intermedium interiectumque corpus conuolat et sparsus evehitur. Medium autem id corpus, aut aër est, aut aqua, nam pisces et aquatilia quaeque, quanuis spiritum non ducant, odorari tamen comprobatum est. Quanquam verò iam odor propius ad nares appelletur, non tamen prius poterit respirantibus animalibus odorandi sensum mouere, quàm viae quae è naribus per os summum et meninges in cerebrum pertinent, patefiant, possitque vnà cum attracto ductoque spiritu, odor vt ad pulmones, sic ad cerebrum olfactumque permeare. At quibus promptus atque expositus in aperto est odoratus, neque operculo tanquam vallo quodam communitus, vt apibus, et insectis (sic enim recentiores Latini, nec ineptè appellant) ea ad odores è longinquo conueniunt, et citra vllam respirationem olfactiunt, ipsique odores non attracti illorum sensum feriunt et incitant. Quod ipsum piscibus et his quae in humore degunt accidit. Nam sine anhelitu et spiritus reciprocatione videntur odorari. Ad illorum similitudinem accedit et visio. Color enim aut fulgor perspicuum medium collustrans, in conspectum oculumque cadit. Id medium aut aër est, aut aqua, aut vitrum, aut cornu, aut aliud quod istorum naturam imitatur. Haec autem si idonea futura sunt ad videndum, perlucida fieri oportet et luminis praesentia collustrari. At lumen neque corpus est, neque quicquam quod à corpore excidat aut defluat, alioqui pedetentim neque puncto temporis posset medium omne circuniectum illustrare, neque in perspicuum corpus omnino penetrare. Itaque lumen est actus et perfectio perspicui, ex lucidi corporis praesentia. Quicquid aspectum ciere debet, id si simplex color est, in medio perspicuo eoque illuminato oportet constitui: si verò splendidum et fulgens est, vt fungus, vt putre et praeacidum lignum, [P137] vt vermis, et quicquid noctibus collucet, conspici quidem non potest in lumine, quia exiguum eius lumen, maioris splendore offunditur: at in tenebris istorum vnumquodque videtur sensumque ferit, quòd proximum et circumfundentem aërem leuiter illustrat, vt se potissimum vendicet à tenebris. Ignis verò quòd ancipitis sit naturae, et in tenebris et in lumine videtur: noctibus enim suo lumine propinquum aërem illustrat, vt non is modò, sed alia etiam videri possint: interdiu verò perspicuum iam medium tanquam

with the internal air; its reconnoitering and assistance enable the image of the noise to be perceived and passed on to the headquarters of sensation.

These points will be more lucidly weighed up in the case of smell. Cedar, frankincense and other perfumes when lit and heated give off a pleasant odor, which is present in a sort of dry smoke. Little by little, like a vapor, this flits through the intervening body and is scattered abroad. The intervening body is either air or water, since fishes and all aquatic creatures have been proven to scent things, although they do not draw breath. But although the odor is now propelled closer to the nose, it will still be unable to affect the sense of smell in animals that breathe, until the paths from the nostrils through the bone at the top and the meninges into the brain open up, and the odor can accompany the spirit drawn in, so as to succeed in reaching the brain and the sense of smell, as it does the lungs.

But creatures such as bees and insects (as the more recent Latinists call them, not inappropriately¹⁹) that have their [organ of] smell ready out in the open, unprotected by any rampartlike cover, gather to odors from a distance, and detect smell without any breathing; the odors impinge upon and stimulate their sense without being drawn there. This is actually what happens with fish and things that live in water ["humore"]; they appear to detect smell without the intake and output of breath.

Vision too resembles these. Color or brightness, illuminating a transparent medium, comes within the scope of vision and the eye. The medium is either air or water or glass or horn, or anything that imitates their nature. If these are to be suitable for sight, they should become very transparent, and be lit up by the presence of light. But light is neither a body nor something that flows out from the body; if it were, it could light up all the surrounding medium only little by little, not instantaneously, and could not make its way into a transparent body at all. And so light is the action and completion of the transparent, through the presence of a shining body. Anything that is to evoke seeing, if it is a simple color, should be established in a clear and lit medium; if it is glowing bright, like fungus, or very dry rotten wood, or a [P137] worm, and anything that glows in the dark, it is invisible in the light, because its scanty light is overwhelmed by the greater brightness; but in the dark each of these is visible and impinges on the sense, because it slightly illuminates the adjoining air all around, to free itself in the best way from the darkness. Fire, however, being of an ambiguous nature, is visible both in darkness and in light; at night it illuminates the adjacent air with its light, so that not just it but other things too can be seen; in the daytime it sets in motion what is then the transparent medium, just as a

color aliquis mouet. Fit autem visio quum perspicuum illuminatúmque aërem medium rei color aut imago afficit, aër deinde adusque oculum protensus affectúsque aspectum concitat. Tum enim rei aspectabilis imago per pupillam in crystallino humore excipitur. Hinc demum prouehente spiritu, per opticos neruos in cerebrum et commune sentiendi principium confertur. Hoc autem discrimine ab auditione et odoratione seiungitur, quòd in his motione non derepente, sed paulatim per media facta, sensus feriat: in visione autem non progressionem, sed subitò facta medij aëris mutatione, quemadmodum et luminis appulsu, rei species cernendi obtutum statim mouet. Vnde intelligi potest non defluentibus quibusdam quasi exuuiis à re conspecta ad oculum demissis visionem fieri, quia non continuò vt objecta res est videretur: et priùs propinquo quàm distant se proderet. Adde quòd tanta coloris aut imaginis amplitudo exiguo oculo excipi non possit. Neque praeterea visio fit, foras à conspectu erumpente lumine, quod cum alio externo iunctum coëat: nec spiritus radio ab oculo per medium in objectam rem incidente, qui pari angulo resiliens in obtutum referatur. Quomodo enim tantus prodire possit, qui repente ad astra vsque pertineat, omnémque interiectum aërem quantus est impleat? Quod ad istius fidem afferri solet de basilisco, aut muliere cui menstrua defluit purgatio, inefficax prorsus et irritum videtur: nam neque basiliscus hominem interimit, neque mulier quum menses profluunt speculum praesertim aeneum polluit atque foedat, videndi spiritu ab oculo manante, sed tetro quodam et diro vapore, qui foras vt ab ore et à reliquo corpore, sic etiam ab oculis erumpit et emanat. Haec est eorum sensuum ratio, qui non nisi medij cuiusdam interposito objectas sibi res comprehendunt. Gustus autem et tactus medio corpore non indigent, sed coniunctione quadam et contrectatione functiones suas obeunt. Etenim si vel vapor in gustandi neruum, vel calor pungénsue stylus in nudum apertúmque tangendi neruum incidit, eximiè et acriter sentitur, quamquam nulla caro media intercedit. At verò si aut pupillae rem candidam adiicies, aut aëri qui auribus est ingenitus strepitum inculcabis, aut in narium ductus odorem penitus immittes, nulla omnino vel obscura erit perceptio. Itaque sapor succo humorique permistus, aut (si rectius mauis) in humore constitutus (eius enim qualitas quaedam est et affectio) simulac adhibetur admouetúrque linguae, diffusus cum humore gustum incitat, móxque species eius, et imago vi spiritus in primatem sensum infertur. Quod si fortè in duro concretóque corpore, vt in sale sapor erit, id non antè poterit sensum mouere,

color does. Vision takes place when the color or image of a thing works upon transparent and illuminated intervening air, and then, having been extended right to the eye and been influenced, the air arouses sight. At this time a visible image of the thing is received in the crystalline humor through the pupil. Finally, conveyed by spirit, it reaches into the brain and general sensory headquarters, along the optic nerves. It is distinguished from hearing and smelling, in that in these the movement that impinges on sensation is not instant, but produced gradually through the media. In vision, it is not by a progression but by an abrupt change in the intervening air, as happens also with the impact of light, that the form of a thing sets the visual gaze in motion at once. It follows that vision does not come about through a sort of skins shed from the thing seen and transmitted to the eye, because it would not look like the object at once, and would present itself sooner to a nearby viewer than to a distant one. In addition, such a width of color and image could not be received by a small eye. Vision does not come about either through light bursting out from the gaze to unite itself with something external, nor through a ray of spirit from the eye through the medium falling onto the object, and being reflected at an equal angle to return to the gaze. How could a ray extend out large enough to aim instantaneously right to the stars, and to occupy all the air between, however vast?²⁰ A tale commonly told to support this, about the basilisk, or a woman whose menstrual flow is going on, seems entirely invalid and void: neither does a basilisk kill a man, nor does a menstruating woman stain a mirror (especially a bronze one) with visual spirit emanating from her eye, but with a foul and dreadful vapor, which issues violently to the outside from her mouth and the rest of her body, as also from her eyes. The above is the account of the senses that grasp their objects only with the intervention of some medium. But taste and touch need no intervening body; they perform their functions by a sort of contact and touching. For if a vapor impinges on a gustatory nerve, or heat or a pricking spike on an exposed nerve of touch, it is felt exceptionally keenly, although no flesh comes in between. But if you expose the pupil to something white, or drive home a noise at the air inherent in the ears, or insert an odor deeply into the nasal passages, there will be no perception at all, or [only] an ill-defined one. And so a flavor mixed with juice and humor, or (if you prefer [it put] more accurately), established in a humor just at the time it is applied to the tongue (for it is a quality and disposition ["affectio"] of the humor), diffuses along with the humor and stimulates taste; next, its form and image are imported into the primary sense through the power of spirit. If the flavor is in a hard composite body, such as salt, it will not be able to set the sense in motion

quàm calore liquefactum et dilapsum diffundatur. Quicquid autem mollitia fluere et effundi non potest, gustandi sensum prorsus non afficit: quemadmodum neque cui arida et scabra lingua ex morbo torretur, is bonus esse potest saporum aestimator. Tactionem porrò fieri constat, si tractabiles qualitates qualescunque eae sint, aut carnis, aut etiam nullius corporis interuentu proximè ad tangendi neruum accedant. Contendit Galenus in extremis corporis partibus tactum proximè fieri, nulla qualitate per neruos in sentientis animae principatum relata:⁶ neruum cerebri, veluti surculum arboris partem esse, in eoque cerebri totam vim contineri, quae tractabilium qualitatum affectiones discernat: in eo autem sensus facultatem consistere, in quo quidem et sensus inest doloris. Quod profectò si conficit, idem de aliis quoque sensibus erat afferendum. Horum siquidem nerui tum molles sunt, tum substantiae cerebri finitimi, vt idcirco ad illius naturam propriùs [*sic*] debeant quàm tangentes nerui accedere. Deinde verò quae tangendi neruis interceptiones et obstrukciones obtingunt, subditis particulis sensum motúmque adimunt: quod dilucidè commonstrat tangendi vim non esse neruis ingenitam, sed à cerebro [P138] quemadmodum et reliquas continenter defluere et illabi: neque externum tactum posse rerum qualitates diiudicare, sed instrumentum duntaxat eius esse facultatis, quae princeps in cerebro consedit, illúque oportere omnium sensa conferri. Haec singula mihi satis videtur Hippocrates duobus confirmasse aphorismis, quorum altero ait, Dolentes parte aliqua corporis, si omnino dolorem non sentiunt, iis mens aegrotat. Altero, Duobus doloribus non eodem in loco infestantibus, qui vehementior est, alterum leuiorem obscurat. Hoc igitur omni sensui commune est, vt perpetiando sentiat: primùm enim sensus omnis ab subiecti corporis qualitibus afficitur mutationémque subit. Haec ista mutatio sensus nondum est, sed quae fit eius apprehensio atque cognitio. Quum enim princeps illa sentiendi vis ab arce cerebri per neruos in sensus singulos distributa, affectiones quae illis obtigerunt percipiet, tum quodammodo et rudiùs sentire dicitur: propriè verò quum eas cerebro communi sentiendi principio renuntiabit. Sensum autem affici immutarique ab externis qualitibus, non sic propriè audiendum est, vt priore qualitate excussa nouam accipiat: neque enim à colore albescit oculus: neque à sono exacuitur aut obtunditur auditus, neque à dulcedine palatum dulcescit. Sed vt aureum sigillum in ceram, non aurum, sed imaginem imprimit, sic propemodum et res externae

until it is liquefied and dissolved by heat, and becomes dispersed. Anything that is not fluid enough to flow and to stream forth does not affect the sense of taste at all; for instance, no one can be a good judge of flavors whose tongue is dried up and rough from baking by disease. Moreover, it is accepted that touch occurs if the tangible qualities (of whatever sort they may be) are in very close contact with a tactile nerve, with either flesh or no body at all in between. Galen maintains that it is in the bodily extremities that touch occurs most directly, without any quality being conveyed along the nerves into the headquarters of the sentient soul;²¹ a [tactile] nerve is a part of the brain, as a branch is part of a tree, and the whole power of the brain resides in it, to distinguish what has happened to the tangible qualities; in it resides the faculty of sensation, and there too the sense of pain. Assuredly, if it operates thus, the same was to be proposed in relation to the other senses too, so long as their nerves are soft, and also of a substance similar to the brain's, in which event they are bound to approach more closely [reading "propius"] than the tactile nerves to its nature. But then interruptions and blockages that befall the tactile nerves deprive the parts subject to them of sensation and movement; this very clearly shows that the power of touch is not innate in nerves, but flows continuously from the brain, [P138] like the rest too. Further, external touch cannot assess the qualities of things; it is just the instrument of the faculty that is the main one resident in the brain, and the sensations ["sensa"] of everything must be conveyed to there. Hippocrates appears to me to have established these details sufficiently by two aphorisms: one says, "If those suffering in some part of the body do not feel pain at all, their mind is sick,"²² and the other, "When two pains harass, in different places, the more violent one masks the milder one."²³ Consequently every sense has this in common, that it senses by what it undergoes. In the first instance every sense is influenced and changed by the qualities of the subject body. This change is not yet a sensation, but is what becomes its grasping and comprehension. When the main power of sensation, shared out by the cerebral citadel along the nerves into the individual senses, perceives the affections they have undergone, then it will be said to sense after a fashion, and rather crudely: but this happens properly when it announces those to the general headquarters of sensation. The phrase that sensation is affected and altered by external qualities is not to be interpreted correctly as meaning that it takes on a new quality, the previous one having been expelled: the eye does not turn white from the color [white; or possibly "from a color"], nor is hearing sharpened up or blunted by a sound, nor does the palate grow sweet from a sweet taste. But a gold seal imprints onto wax its image, not the gold; in practically the same way external

sola forma sensum impellunt, eorúmque simulachra et species sine materia ad sensum perueniunt, quas hic foris illapsas intra se admittit praealtè condendas. At verò quam sensus imaginum impressionem dicitur accipere, non partium eminentia, vt quae annulo signatur, iudicamus. Nam colori, saporì, odorì qualis figura decernetur? Nullam igitur ille conuersionem mutationémve sustinet, neque priorem statum exuit, quin potius dum in rerum cognitionem et iudicium incumbit, quem statum habebat, agendo gerendóque excolit, perficit, et confirmat.

Sensus interioris functiones. Cap. XI.

QUAE SIC communiter in sensus omnes ab externis rebus inuehuntur imagines, non modò habentur et consistunt, dum sensus in gestione actúque sunt, sed etiam quum abiunctis rebus externis ab opera discessere, moram quandam in illis trahunt atque retinentur. Ita enim si quis de Sole in opacum se conuertat deflectátque, primùm offusus nimio splendore nihil cernit, deinde veluti album quiddam aut viride, quod in puniceum mox se conuertet, proximè in purpureum, atque ita deinceps in alia, postremò in atrum, à quo demum euanescit. Si quid rubrum aut viride conspexerit, quicquid deinde ob oculos incidet, concolor apparebit. Si ocysimè in labentem amnem oculos coniiciat, ex ea vertigine quaecunque stant in littore moueri videbuntur. In aliis porrò sensibus à validis ingentibúsque sonis strepitus relinquitur: à vehementi foedóque odore, olfactus foeditatem aliquantum retinet, fitque in reliquis similiter. Iam verò sensuum instrumentis acceptae formae illae speciésque rerum, mox per neruorum capacitates atque ductus vehente spiritu in cerebrum commeant: adeò vt quum sensus exterior rerum quae foris sunt occurso pulsatur, interiorem pariter impellant et excitent illarum simulachra. Haec enim sensus interioris obiecta sunt, in quae is incumbit, quemadmodum externi in res externas sibi obiectas. Itaque species illae rerum ab externis sensibus praeteruehuntur et permeant in commune idémque principium, in quo sita est primaria sentiendi anima, huic sensus suis quique officiis omnia annuntiant spiritu inuecta, quae ante se posita prima cognoscendi facultate comprehendit ac percipit. Estque illius munus perceptio atque cognitio: quae si fixa est, attenta et diuturna,

things too push with their form alone against a sense, and their images and forms, devoid of material, reach the sense, which receives them within itself when they have slipped in from outside, for storage deep within. However, we do not assess the imprint of images that the sense is said to receive according to the imprint's prominent parts, like a signet ring's imprint; what sort of shape will be determined for a color, flavor, or smell? So a sense undergoes no change, nor does it shed its earlier condition; rather, by working upon this previous condition, it improves it, perfects it, and reinforces it, while busy discovering and assessing things.

Chapter 11. Functions of the internal sense.

THE IMAGES thus conveyed generally from external things into all the senses exist not only while the senses are in actual operation, but also when they have given up their effort, upon the removal of the external things, and they [the images] are assigning a sort of persistence to them [external things], and being retained. Thus, if one turns away from the sun [to look] towards a dark place, initially one sees nothing, having been overwhelmed by the extreme brightness; then a sort of whiteness or greenness, which soon alters to scarlet, next into purple, and thus successively into others and finally into black, from which ultimately vanishing occurs.²⁴ If one has looked at something red or green, whatever next comes before the eyes will seem of the same color. If one directs one's eyes very quickly at a flowing river, after [or, "from"] the whirling movement everything on the bank will seem to be in motion. Further, in the case of other senses: an enormously loud sound leaves a ringing behind; after a powerful stench the sense of smell retains some nastiness; and it is similar with the others. These forms of things, once received by the instruments of the senses, then proceed along the cavities and channels of the nerves into the brain, borne along by spirit, to such effect that when the outside world impinges upon the external sense, they thrust upon the internal sense correspondingly, and evoke images of that world. The images are objects of the internal sense, to which it applies itself, in the way that the external senses apply themselves to their external objects. And so these forms of things pass along from the external senses, and make their way into the same common headquarters, in which the primary sentient soul is located; as its duty, each sense delivers to it all the messages brought in by spirit, messages it grasps and perceives when they are set before it by the primary faculty for getting knowledge. Its [the sentient soul's] function is perception and knowledge; if it is unwavering, close, and prolonged,

cogitatio aut meditatio dici solet. Atque quanuis expers ea sit corporis, individua et vna, quia tamen complurium potestatem habet, multa et varia cognoscit, horum discrimina cernit, eaque tandem diiudicat. At nequaquam illa componit connectitque, vt ex eis verum aut falsum quicquam constituat, aut vllam argumentationem concludat: id enim solius est mentis et intelligentiae, de qua mox dicetur. Verùm quaecunque comprehenderit simplicia et individua simulachra, aut seorsum illa discernit, aut temerè congesta, nullo copulatione [P139] ne, nulla complexione in aceruum confert. Quò fit, vt actio ea qua vel gallina pullos primùm cognoscit, deinde discernit, vel ouis lupum inimicumprehendit, secretio potius censi debet, quàm iudicium aut existimatio. Sub haec autem insurgens et in opus erumpens conseruatix illius facultas, suscepta è sensibus simulachra amplectitur et continet, móxque tum propria vi et potestate, tum illorum adnixa et impulsu, in cerebri corpore illa insculpit et consignat, citra vllum materiae vestigium, ea autem diutius manent abeunte et cessante omni rerum cognitione. Haec quidem eorum conseruatio quaedam est memoria, quam frequens stabilit meditatio. Spectra cerebro inusta aliàs alia se magis minúsve expromunt et obiciunt animae sentienti, prout illustriùs obscuriùsve impressa fuerint. Inter vigilias igitur quum externarum rerum turba et occursatione primarius sensus non admodum distractus tenetur, tum simulachrorum stimulis agitatus in ea penitus incumbit, atque tum vsus comminiscendi illa et fingendi facultate, quae Graecis est φαντασία, illa quidem per se, et vt simulachra sunt, obuertit, aliàs quidem simplicia et qualia fuerant insculpta, aliàs commista atque confusa citra vllam compositionem aut copulationem. Neque hoc tantùm, sed ex illis quoque nouas formas et simulachra effingit, quae nunquam sensibus percepta fuerant, et in ea plerumque trahitur, quae rerum natura et vniuersi ordo non admiserit, vt in Sphinges, Hippocentauros, tripites homines, atque in huius generis monstra innumera. Haec eadem altius sese attollens, nonnunquam (vt ouis viso lupo) ex spectris horrendum quiddam et formidolosum comminiscens, inimicitiam elicit sensu non perceptam: at si delectamentum quoddam iucundè comprehendet, vt ouis conspecto benigno pastore, amicitiam suscipiet et inducet. Sic tamen illa fingens omnia commiscet et congerit, citra aptam compositionem, ex qua verum aut falsum elici possit, et citra vllam rationis complexionem, quae serie quadam rerum et sententiarum ex aliis alias connectat.

it is usually called learning or reflection. And though it lacks any body and is undivided and single, it learns many different things, makes out their distinctions, and in the end discriminates between them, because it has control over a number of things. But it does nothing to compare and link them, so as to establish anything true or false from them, or settle any argument; that is for the mind and intelligence alone, which will be mentioned presently. All the simple indivisible images it has grasped, it either separates out or piles at random into a heap, without any association or [Pr139] combination.

Consequently the way ["actio"] that a hen first becomes aware of her chicks and then distinguishes them, or a sheep gets a sight of a hostile wolf, should be regarded more as a selecting than as a judgment or opinion. Its preserving faculty, arousing in response to these [perceptions, perhaps] and breaking out into the task, clasps the images taken up from the senses, and then, both through its own power and potentiality, and through their support and impact, it engraves and records them on the cerebral body, without any trace of material, and they persist while all recognition of the things is departing and ending. This preservation of them is a sort of memory, which frequent reflection fixes firmly. Of the specters of things branded into the brain, different ones at different times project more or less and present themselves to the sentient soul, in keeping with their clearer or dimmer imprint. During [nocturnal] wakefulness, therefore, the time when the primary sense is not distracted at all by the confused onset of the external world, is the time when it is stimulated by images and applies itself completely to them; and when it employs the celebrated faculty of recalling and simulating, which the Greeks call *fantasy*, it attends to the images in themselves and as the images they are,²⁵ sometimes simple ones and [just] as they had been engraved, sometimes mixed up, without any structure or link. It does not stop there, but also fashions out of them new forms and images, which had never been perceived by the senses, and is often inclined to possibilities that the nature of things and the order of the universe have excluded, such as Sphinxes, Hippocentaurs, three-headed people, and innumerable monsters of this kind. This same [faculty], rising to further heights, sometimes recollects from specters something horribly terrifying, and summons up a hostility not perceived by the senses, like a sheep when a wolf seems to appear ["lupo viso"]. But if it grasps some pleasant delight, like a sheep at the sight of a kindly shepherd, it will adopt and take in friendliness. However, simulating all these things in this way, it mixes them up in a heap, without a suitable structure from which truth or falsehood can be extracted, and without any reasoned combination, which links one to another in a sort of sequence of things and opinions.

Hae quidem sunt beluarum functiones praestantissimae, iis quodammodo respondententes, quas ratio et intelligentia in nobis efficit. Veruntamen quanto hae interuallo distent ab illis, palàm et apertum fiet de sequentibus. Ab actionibus autem discernentis facultatis hae distant et eo discrimine seiunctae sunt, quòd illae sint comparationes et collationes quaedam eorum quae ex sensibus hausta acceptaque fuerant, hae verò nouae sunt confictiones formarum, quae sunt supra sensum, ab his ductae quae aliquando sub sensum inciderant. Iam verò quum accidet primatem sensum sic derelicta seruatque spectra contueri, vt non illa per se duntaxat contempletur, neque ex illis in nouas effigies abeat, sed ex illis vsus opera facultatis memorandi in res externas se referat, vnde spectra illa prodierant, simulque percipiat se aliquando illas cognouisse, tum meminerit earum, eritque ipsa illius actio memoria, non illa quidem patiendi, sed planè efficiendi. Eae quidem sunt functiones omnes, quas primarius ille sensus et promiscuus, inter vigilias facultatum suarum opera obit et exercet. At quando fieri non potest vt perpetua sit sensus agitatio, sed necessum est, quum spiritus vigiliis supra modum disperditi fuerint atque dissipati, agitationis vigorem prolabi et quietem cessationemque suffici, tum procul dubio arctior somnus obrepet. Aut quum larga frigidi humoris eiusque superuacanei copia superioribus sedibus se immiscuerit velut in lethargo, vbi quasi nexu quodam et impedimento sic primus sensus offunditur, vt se minimè possit extricare: somnus vtique intercedit, et functiones omnes concidententes deiectaeque, manus dant sopori. Si arctior atque profundior somnus occupat, non modò externi sensus, sed et interiores facultates consopitae iacent, vt neque discernere, neque fingere et comminisci quicquam possint, nullamque in illas vim habet spectrorum turbulenta concursio. Vnde tum nullum insomnium offendit, aut obuersatur: eaque ratione statim à cibo non somniant animalia, neque quum primum egressa in lucem sunt, vt infantes. Si verò contrà accadat, vt leuiter quis obdormiat, neque vaporis humorisve copia discernendi comminiscendique vires obterat et praestringat, licet tum fortasse multa ante sensum visa, multaeque motiones obuersentur, eas tamen insomnia non dicimus, vt neque is [P140] is [sic] verè somnus est, qui minimum à vigilia deficit. Quum enim hoc tempore et statu incolumis sit et libera vis discernendi, quaecunque tum simulachra vim illam fictricem exagitant et impellunt internoscit et detegit, neque illorum errore trahitur: sed quum nocturna spectra occurrent, agnoscet

These are the most outstanding functions of beasts, and correspond after a fashion to those that reason and intelligence carry out in us. But how great a gulf there is between the two [sets of functions] will become perfectly clear from what follows. The latter [the human set, apparently] differ and are separated from the actions of the distinguishing faculty by the point that the former [the beasts' set, apparently] are comparisons of what had been drawn in from the senses, but the latter are new fashionings of forms, which rank above sense, being derived from what had at some time presented itself to sense. And now the primary sense happens to gaze thus at this legacy of specter, so that it does not just dwell on them in themselves, nor pass on from them to new specters, but by using the support of the faculty of memory transfers itself from them onto external things, from which those specters had proceeded; this is the same time when it perceives that it had once been acquainted with them, then it recalls them, and this action on its part will be memory, not the memory of undergoing something, but of obviously achieving something.²⁶ These are all the functions that this indiscriminate primary sense discharges during lying awake, by the activity of its faculties. But endless stirring up of the senses is impossible, and when the spirits are excessively scattered by wakefulness, the force of the stirring has to decay and a quiet break has to be provided; at that time quite a deep sleep will surely steal in. Again, suppose a liberal supply of cold and also redundant humor has merged itself with the higher seats, as happens in torpor ["lethargus"], when the primary sense is so overspread with a clattering complexity that it can barely clear itself; sleep necessarily intervenes, and all functions collapse, and surrender to sleep. If a deeper sleep comes on, not only the external senses but also the internal faculties lie slumbering, unable to distinguish or to fashion and recall anything, and the disorderly crowd of specters has no power over them. Hence at the time no dream vision ["insomnium"] upsets them or passes before them; and on that basis animals do not dream at once after food, nor when they have emerged into the light for the first time, as infants. But if the opposite occurs, and someone falls lightly asleep, with no abundance of vapor or humor impairing and restricting the powers of discrimination and memory, then there may well be, perhaps, many sights and movements presenting themselves before the senses; yet we do not call these dream visions ["insomnia"], for something that differs very little from wakefulness is not really [P140] sleep. As the power of discrimination is unimpaired and free then and in these circumstances, it distinguishes and reveals any images that disturb and assail the imagining power at the time, and is not entrained by their deviousness. But when nocturnal specters make their appearance, it will

tum se dormire, tum somnia ea esse quae videntur, neque illis tanquam veris assensum adhibebit. Eodem prorsus modo afficiuntur, qui in leni nec profunda quiete, aut canum latratus, aut gallorum cantus excipiunt, de quibus tum quoque sibi somnia confingunt. Caeterum dum ex causarum mediocritate sic placidus et moderatus somnus obrepit, ut discernendi quidem vis offundatur, fictrix autem facultas libera sit, nullisque quasi vinculis irretita, ex rebus quas vigilans gesserit, senserit, cogitauerit, spectra plurima in quiete iactabuntur, quae tanquam res verae sint dormiens intuebitur ac cernet. Vis enim discernendi tum vincita constrictaque non obsistit, atque iccirco ad ea quae visa sunt quasi accepta sensibus veraque sint, assensum dormiens adiungit, nesciens se dormire. Atque id propriè somnium est, nempe visum quod in quiete occurrit, tanquam verum sit existimatum. Eadem propemodum ratio reddi potest eorum quae delirantibus per morbos apparent. Cur autem et vnde accidat, ut tam multiplex et inaudita visorum copia obuersetur, et vnde possit tanta illorum varietas trahi: non aliò sanè potest referri quàm ad corporis humorumque affectionem variamque perturbationem. Affectio enim et constitutio causa est ut in somniis atque delirationibus, alij metuenda et horrenda terrorisque plena iactent animo, alij iurgia quaedam furiosa et effrenata, alij delitias et voluptates plenas iucunditatis. Sic et perturbatio quae corporis aut spiritibus aut humoribus obtigerit, causa est omnino ut spectra et effigies rerum vehementius agitatae appareant, non quales verae sunt, sed distortae, praeposterae et portentosae, quod frequens esse solet in temulentis, et in iis qui febre iactantur. Quibus autem quieta et tranquilla omnia consistunt, nec fluctuantia nec immoderatè agitata, solidae et incolumes à sensibus effigies se obiectant, distincta digestaque somnia occurrunt, ad veri similitudinem expressa.

Vt fiant appetitio atque morales actiones. Cap. XII.

APPETITIO MOTUS est et interior quaedam agitatio, qua quod bonum est et vile quaeritur. Quum autem, ut anima, triplex sit omnino, ea quae naturalis appellatur cunctis rebus est ingenita, et nunquam separabilis semper illis insidet: reliquae non item. Quae sentiens et animalis dicitur, fit dum appetitus aut ab iis quae intus sunt rebus, aut ab iis quae extrinsecus irruunt impellitur. Res interiores sunt venereus ardor et stimulus in pudendis ortus ex semine: ventriculi maximèque stomachi exinanitio et immoderata siccitas:

recognize both that it is asleep and that what is being seen are dreams, and will not contribute assent to them as if they were real. People are affected in just the same way who, during light and not deep sleep, perceive either dogs barking or cocks crowing, and then contrive dreams for themselves out of them. But there is a time when calm and moderate sleep steals in, from an intermediate level of causes, in such a way that the power of discriminating is overwhelmed, but the fabricating faculty is at liberty and enmeshed in no bonds; that is when numerous specters, derived from what the waking person has done, felt, or thought, will cavort about during sleep, and the sleeper will view them as real; the power of discriminating is no obstacle, being constrained at the time, and so the sleeper attaches his assent to what he has seen, as if it were received by the senses and genuine, as he is unaware that he is asleep. This is properly what a dream is, meaning a sight encountered in sleep and taken as real.

Practically the same account can be given of the appearances seen by those who are delirious in the course of diseases. The reason and origin of such a numerous and unheard of supply of sights presenting themselves, and the source of such a variety of them, can only be put down to the affection and varied disturbance of body and humors. The affection and disposition is the reason that, during dreams and deliriums, some people display to their mind fearful and frightful things, others wild unbridled quarrels, others luxuries and pleasures full of charm. In this way the disturbance that has befallen the bodily spirits or humors is the whole reason for the appearance of specters and likenesses of things in violent motion, not as they really are, but distorted, topsy-turvy, and fantastic, as often happens with drunks and those who are tossing in fever. But people with whom everything is quiet and peaceful, not in turmoil nor excessively disturbed, encounter solid and unimpaired representations from their senses, and well-defined and well-digested dreams, modeled on likeness to the truth.

Chapter 12. How appetite and moral actions come about.

APPETITE IS a movement and internal activity by which what is good and expedient is sought. As, like the soul, it is all told of three sorts, the one that is called the natural one is innate in all things, and an inseparable resident in them. The rest are different; the one named sentient and animal comes into being when appetite is the target of things within or of those that intrude from outside. Things within are: erotic desire and the urge originating in the private parts from semen; evacuation and excessive dryness of the stomach and particularly of the

sanguis aut bilis in cordis sinubus efferuescens. Externae autem res sunt, quaecunque subiectae sensibus illecebris et cupiditatum lenociniis eos prolectant et irretiunt. Itaque si in pudendis congesta est seminis copia, ea primò pruritum quendam et titillationem naturaliter inuehit, haec deinde sensum, mox verò interiorem sentiendi facultatem mouet, non modò vigilantibus, sed et plerunque dormientibus nobis. Ab animaduersione demum rei delectabilis vt appetitus impulsus fuerit, eam quàm mox ardentè expetit: atque tum in conditionem stimulantis rei se conuertens, libidinem parit, quae ipsa est propria venereorum cupiditas et appetitio. Quum stomachus supra modum exinanitus tristi quodam sensu afficitur, comprehendens vis illa interior irritata, cibum et epulas concipit, illarúmque spectra sibi obuersat, quae deinde appetitui oblata, eum inuitant et alliciunt: hic demum concitus captúsque rerum suauitate, in illarum desiderium fertur, et in eam cibi auiditatem irruit, quae fames appellatur. Haud dissimiliter aridiore facto stomacho, sitis accenditur, quae humidi frigidíque desiderium est. Vtranque appetitionem, sitim inquam et famem genus vnum comprehendit, quod est cupiditas et cupedia. Caeterùm circa cor bilis aut sanguis efferuescens, illud vsqueadeo incendit, vt odij, inimicitiae, aut vindictae imagines communi sensui obiectet, quibus apprehensis excitatur animalibus appetitus, qui cordis irritamento, compulsus in interiorem animi per [PI4I] turbationem, ceu bonum quoddam sit, incurrit: vniuersum hoc appetitionis genus Graecis est θύμωσις. Quum porrò rerum externarum blandimentis pulsatur vis illa interior apprehendens, mox in illarum desiderium communem sentiendi appetitum adducit, qui ardenti rei vtilis desiderio inflammatus, mox deinde peculiarem quendam appetitum irritat et illicit tanquàm administrum, vt amborum communi concursu et opere appetitio proueniat. Quaecunque boni malíve specie nobis obiecta fuerint, ea si cum ratione sequimur aut fugimus, tum appetitio est rationis particeps: quum autem aduersus rationem incitamur vehementiùs, et delectationis vis est maior quàm rationis, tum contra mentis decretum allicitur appetitio quae ratione vacat. Primùm igitur ab obiectis illis turbido motu et inimicissimo mentis vitaeque tranquillae ratio concitatur et inflammatur, quúmque illa se saepenumero iactant inconstanter vt animi statum conturbent, perturbationes insunt. Hae autem cùm iam diutius inueterauerint, et tanquam in venis medullisque insederint, tum morbi existunt et aegrotationes, quarum omnium fons et veluti genus est intemperantia. Sic enim quum insurgit vehemens vini appetitio, neque adhibita ratio hanc ipsam persanat

gullet; blood or bile boiling up in the chambers of the heart. And there are external things that, when set before the senses, entice and entangle them in the meretricious attractions of violent desires. Thus, if a supply of semen has accumulated in the private parts, it naturally introduces at the start some itching and tickling, which next arouses the sense, and soon the internal faculty of sensing, not just while we are awake, but often during sleep. When in the end appetite has been urged on by noticing a delightful thing, it seeks it eagerly at once; and then, changing itself into the status of an urge, it produces lust, which is itself the specific desire and appetite for sexual intercourse.

When the gullet has been emptied too much and suffers a sense of distress, the grasping power within it is provoked, imagines food and feasting, and displays their specters to itself; they, appearing next before the appetite, lure and entice it. Appetite, then, stirred and beguiled by the attractions, proceeds to a desire for them, and hastens into the eagerness for food that is called hunger. In a similar way, when the gullet becomes rather dry, thirst is kindled, which is the wish for moistness and coldness. One kind [of appetite] embraces both (I mean thirst and hunger), and is greed and gluttony.

Bile or blood boiling up around the heart inflames it to such an extent that it displays before the general sense images of hate, hostility, or vengeance; when they are grasped, in animals appetite is kindled, and driven on by the stimulus of the heart, rushes into [PI41] internal disorder of the mind ["animus"], in the guise of some advantage. The Greeks call this whole kind of appetite "thumosis." Besides, when the internal grasping power is assailed by the charms of outside things, it soon induces a desire for them in the general appetite of sensing, which, inflamed by a burning desire for an advantageous thing, quickly goes on to arouse and entice a specific appetite to assist it; and so appetite issues from the joint assembly and action of both. If with our reason we pursue or avoid everything presented to us in the form of good or bad, then appetite partakes in reason; but when we are more powerfully impelled contrary to reason, and the power of delight is greater than reason's, then an appetite devoid of reason is enticed, in defiance of the mind's command. To start with, therefore, the pattern ["ratio"] of the mind and of a quiet life is stirred up in disorderly harmful motion by these things presented to us, which bring on disturbances when they toss themselves about frequently and capriciously so that they confuse the state of the mind. When these disturbances have become long ingrained, and (so to speak) resident in the veins and marrows,²⁷ diseases appear; their wellspring and (so to speak) kind is intemperance.²⁸ In this way, when a violent appetite for wine arises, and the use of reason does not heal and

et restinguit, tum excitata iecoris et stomachi cupedia se satiat ebrietate, quae si frequens erit, nascetur demum ebriositas: haec quidem aegrotatio est et affectio manens, illa verò perturbatio mouens. Similiter solent caeteri intemperantiae morbi enasci, inhaerere, et penitus inseri. Sic iugi formosae mulieris intuitu et apprehensione, communisque illius et promiscui appetitus incitatione, in testes et pudenda promotio sit et illapsio seminis ac spirituum: vnde licet nulla prius subesset interior causa, tum nihilominus libido incenditur. Sic non modò homines sed equi et beluae, audito tubarum sonitu strepitùque armorum, excandescunt animique impetu rapiuntur. Sic quum quis laesus est iniuria, eius apprehensione vis animosa cordis, quae eius est appetitus Graecis dicta θύμωσις, incitatur, quae cum eam vindicare et vlcisci cupit, neque rationis mansuetudine lenitur, tum ira exardescit: haec si mox desistat, excandescencia dicitur: sin inueterata sit, odium: si acerbior, discordia; si vlciscendi tempus obseruat, inimicitia. Horum omnium offensio contraria est verecundia. Quum vehemens est de diuitiis expetendis opinio, cordis appetitio non refrenata rationis liberalitate, in auaritiam effertur, cui contrariam offensionem habet prodigus. Quum denique maximi fient optimique iudicabuntur honores, horum stimulis haec vis inflammata, in ambitionem trahetur, cuius contraria est animi demissio et abiectio, mediocritas autem animi magnitudo. Sic quidem futuri boni opinione excitari solent cupiditates. Caeterum futuri mali apprehensio, si adeò vehemens erit, vt superato spretòve rationis imperio animus fortitudine non consistat, tum metu conturbabitur: qui si malum propinquum est, timor: hic autem si permanet, formido: si laboris metus erit, pigritia dicitur: si valde concutiat, terror: si mentem de loco mouet, pauor: si vltrà processit, exanimatio. His modis quae cupiditas mala et contraria censuerit, solet effugere. Vbi verò iam mala instabunt, aut sperata bona non accedent, animi fient aegritudines: dolor quidem crucians [read “crucians” with 1542], angor premens, luctus ex interitu, moeror cum fletu, lamentatio cum eiulatu, aerumna cum labore, afflictio cum vexatione corporis, sollicitudo cum cogitatione, molestia permanens, desperatio sine vlla rerum expectatione meliorum. Contrà verò si potiatur rebus secundis, aut aduersis ipse careat, voluptate perfruetur: haec autem si placida est atque constans, gaudium dicitur, si profusa et inanis, laetitia; si magis gestiens et se efferens insolentiùs, iactatio. Ex quibus intelligitur animalem appetitum vnicum esse, qui cupiditas appellatur, sed dum singulis sese accommodat,

quench it, the greed of liver and stomach that has been evoked sates itself in getting drunk; if this often happens, in time addiction to drink will develop. It is a persistent disorder, while getting drunk is a transient disturbance. The other diseases of intemperance usually originate and become completely implanted in the same way. Similarly, constantly gazing at and embracing a beautiful woman, and stirring up the usual ["illius"] universal ["communis et promiscuus"] appetite, brings the transfer and gliding of semen and spirits into the testicles and private parts; hence, even if there were no previous underlying internal cause, nevertheless lust is kindled. Similarly, when the blare of trumpets and the clash of arms is heard, not only men but horses and beasts flare up and are carried away by the rush of their mind ["animus"]. Similarly, when anyone has suffered injury, its recognition stirs up the impetuous power of the heart, which is its appetite known in Greek as *thumosis*; when this appetite seeks vengeance, and is not soothed by the mildness of reason, wrath is kindled; if it is soon over, it is called a flare-up; if it gets established, dislike; if more bitter, strife; if it bides its time for revenge, enmity.

To be affronted by all these things is the opposite: modesty. When there is a strong view on the search for wealth, the heart's appetite, without the restraint of reason's generosity, makes off into avarice, which affronts the prodigal. In fact, when honors get very great and are considered excellent, this power [heart's appetite, presumably] is fired by their urging and will be drawn into competing for them; the opposite of this is discouragement and submissiveness, and the intermediate level is magnanimity. Desires are commonly stimulated by optimism in this way. But pessimism, if so powerful that the mind loses its courage, reason's rule being overthrown or despised, will be confused by concern;²⁹ if the evil is near, there will be fear; if it persists, dread; if there is concern about work, it will be called sloth; if it is powerfully upsetting, terror; if it displaces the mind, trepidation; if it goes further, panicky paralysis. In these ways it usually evades what an evil perverse desire has commended. But when evils are already pressing, or the expected benefits do not accrue, sicknesses of the mind ["animus"] will come on: torturing pain, oppressive distress, grief because of death, gloom with weeping, mourning with wailing, affliction with toil, distress with bodily hardship, worry with solicitude, lasting unease, despair without any hope of improvement. But on the other hand, if it comes by prosperity, or itself is free from adversity, it will enjoy pleasure. If the pleasure is calm and steady, it is called joy; if it is extravagant and unsubstantial, happiness; if it is more exultant, and carried away without restraint, showing off. It follows that animal appetite is a single one, called desire, but in adapting itself to

varias parit cupiditatum differentias, honoris, gloriae et diuitiarum ambitiones, quae ad θύμωσιν et animi impetum referuntur, quasque Plato ex corde nasci commemorat: quum verò corporis bona procurat, cupediam et libidinem excitat, idque primùm è iecore. Vnde quum tria sapientiae studiosi bona statuerint, alia corporis, alia fortunae, alia verò animi: quúmque omnis appetitio boni cuiusdam aut veri aut ementiti gratia sit, in idque referatur, quae ex iecore surgit concitatúrque appetitio, in corporis bona duntaxat irrumpit: quae autem ex corde manat, in fortunae externis bonis versatur: at quae animi sunt bona, [P142] haec sola voluntas appetituum regina consecratur, de qua seorsum mox disseretur.

De progressionē et tactione. Cap. XIII.

QUONIAM VERÒ vna appetitio cuncta animantia ad mouendum impellit, proximum his est vt de incessu atque tactione contemplemur. Harum quidem operum facultates vna continentur essentia, quae in cerebri corpore collocatur: sed quae tamen variis instrumentis vsa, vnicuique tum operi, tum facultati peculiare quoddam et idoneum accommodat. Non enim tutum fuerat essentiam illam animae in cerebro tanquam in arce positam, in longinquis et extremis corporis partibus munia quaedam obire, nisi satellitibus et suarum virium quasi internuntiis vteretur. Quocirca in omnes sensus externos, in omnes corporis partes, quae extra arcem illam et extra caluam positae sunt, anima spiritus emittit tanquam administros et portitores virium quas à se diffundit, munus quaeque [corrected to "quamque" in Errata at end of the volume] suum expleturas. Interiores autem functiones et munera plenè exequitur, citra vllum spiritus subsidium. Itaque spiritus is verè primum censi debet animae instrumentum, quod ad externas functiones accommodatur: deinde nerui, mox sensuum organa et muscoli. Quòd magna quidem assiduè fiat in motibus sensibúsque spirituum dissipatio, necesse est magnam istorum vim et vbertatem in arce contineri. Eorum materia continenter è corde per carotides suggeritur, praeparatúrque in admirabili contextu, ac dein in choroide vi ambientis cerebri in animalem spiritum conuertitur, qui priores ventriculos prorsus implet. Ex his autem in sensus et musculos, hac ferè lege distribuitur. Cerebri corpus iugi constantique agitatione, cordis more, ex se et sua sponte mouetur, nunc se in amplum diffundens, nunc in angustum reducens: quapropter inter meninges inane spatium natura reliquit, quantum cerebri dilatationi conueniret. In eo motu dum cerebrum se contrahit,

individual things it generates different sorts of desires, rivalries for honor, glory, and riches, which are assigned to thumosis and an impulse of the mind ["*animus*"], and are described by Plato as originating from the heart. But when it attends to bodily benefits, it arouses desire and lust, initially from the liver. Those who are actively interested in wisdom have established three [types of] benefits: some of the body, some of the fortune, and some of the mind ["*animus*"]; and all appetite is for the sake of, and concerned with, some benefit either real or bogus; hence the appetite that is stirred up from the liver penetrates only into bodily benefits; the one that emanates from the heart relates to external benefits of fortune; but the [P142] will alone, the queen of the appetites, pursues benefits of the mind; separate discussion of it will take place soon.

Chapter 13. Forward motion, and touching.

AS THERE is a single appetite that impels all animals to move, the next item for us to consider is walking and touching. The faculties of these actions are present in a single essence, which is sited in the body of the brain. However, it makes use of various instruments to furnish something particular and suitable, both to each action and to each faculty. It was unsafe for this essence of the soul, located in the brain as if in a citadel, to perform functions in remote extremities of the body, unless it used henchmen and (so to speak) intermediaries of its powers. Accordingly, the soul sends out spirits like servants and porters carrying the powers it distributes from itself, each power to discharge its own function, and sends them into all the external senses, into all the bodily parts that lie outside that citadel and outside the skullcap. The internal functions it fully performs without any help from spirit. And so this spirit should really be regarded as the first instrument of the soul, which is suited for external functions; then come the nerves, after them the sense organs and the muscles. Because a great dispersal of spirits goes on all the time in movements and sensations, their great power and abundance must be held in the citadel. The material for them is supplied continuously from the heart through the carotids, and is made ready in the marvelous structure [*rete mirabile*], and then converted to animal spirit in the choroid [*plexus*] by the power of the surrounding brain; this spirit completely fills the anterior ventricles. It is distributed from them into the senses and muscles, on this general plan: the body of the brain is in unending movement, like the heart, of itself and its own volition, now expanding and now contracting. Nature has therefore left empty space between the meninges, the amount required for cerebral expansion. While the brain contracts in the course

compressisque lateribus interiores sinus coarctat, spiritus è prioribus ventriculis, tum in posteriores, tum in sensuum instrumenta profundit. Dum autem sese latius explicat et aperit, ex contextuum arteriis vitalem spiritum, ex naribus aërem allectat et attrahit. Hoc ipso temporis momento via quae ex tertio ventriculo in postremum ducit, prorsus conniuet, et ab insidente epiphysi cui à verme nomen est, inter glutia concidente atque prolapsa intercluditur, vt nihil spiritus possit tum ex postremo illo sinu in medium remigrare. Contrà verò accidit in cerebri contractione: epiphysi enim sublata, ipsisque glutiis amplius diductis, via patet liberior, qua spiritus ex tertio sinu in quartum influat. Quantum igitur cordi valuae, tantum cerebro vermis et glutia conducunt. Sic diffusi dispersique spiritus, irrigant impléntque sensuum instrumenta: sic postremus ille ventriculus spiritu semper confertus, qui leui quadam mutatione accepta in eam capacitatem illabitur et influit, quae per spinae longitudinem porrigitur. Excavata enim est tota haec medulla medio intimoque ductu: et qui ab hac prodeunt nerui maiores, suis ij quoque exortibus et initiis luculenter caui sunt. Quocirca in hos etiam animalis spiritus è medulla defluens illabitur, qui demum in extremas tenuissimásque [read "tenuissimásque" with 1542] neruorum fibras diffunditur, tametsi hae prae exilitate cauae non sunt, neque vllam viae productionem sustinent. Hoc igitur loco quàmplurimi in quaestionem disceptationémque vocant et quaerunt, ipsáne spiritus animalis substantia dum motus sensúsve instituitur, commeet in neruos. Hanc quidem vsque eò influere, dum manifesta sit medullae et neruis capacitas, perspicuum quidem est, de quo etiam inter omnes planè constat. At longius in reliquas partes dimanare, pauci admodum sibi persuaserunt. Quamobrem? Quoniam, inquiunt, hae excavatae non sunt. Quasi verò spiritus qui tenuissimus est patentem alueum vbique desideret, neque sensim illabens possit neruos irrigare. Si alimentum quod neruos nutritur et alit, in eorum substantiam irrepit et penetrat, si crassus et lentus humor, si pingue oleum instillatum penitus illos subit, quid causae est cur spiritus animalis, tenuis ille quidem et aethereus, non possit omnem eorum substantiam quoquouersum peruadere? Quemadmodum igitur in neruos opticos oculorum, et in medullae capacitatem, inque neruorum origines hunc illabi et influere sensus iudicat, ita et eundem in reliquam [P143] illorum substantiam pertinere, haec rationum momenta confirmant. Adde, intelligi vix posse qua ratione conueniens virium facultatisque distributio fiat citra vectorem spiritum. Quum vitalis spiritus in animalem commutatur,

of this movement, and narrows its internal cavities by squeezing their sides, spirit pours out from the anterior ventricles, both into the posterior ones and into the instruments of the senses. But when it enlarges and opens itself out, from the arteries of the structures³⁰ it entices and pulls vital spirit, and from the nasal cavities, air. At that very moment, the pathway that leads from the third ventricle to the posterior one closes down completely, and is blocked by the descent of the process that is named after a worm, settling and slipping down between the “buttocks” [corpora quadrigemina], so that no spirit can retrace its path from the posterior ventricle to the middle [third] one. The reverse occurs when the brain contracts: the process is raised, and the “buttocks” themselves draw further apart, so that the way is more open for spirit to run from the third ventricle into the fourth. The “worm” and the “buttocks” contribute as much to the brain as the valves do to the heart.³¹ Dispersed out in this way, the spirits irrigate and fill up the sensory instruments; in this way the posterior ventricle I mentioned [“ille”] is always filled with spirit, which with slight change flows into the cavity that runs the length of the spine. All this spinal cord [“medulla”] is hollowed out by a central inmost channel; and the larger nerves that stem from it are also strikingly hollow at their origins.³² Consequently animal spirit, running down from the spinal cord [“medulla”], glides into them too, and ends by diffusing into the final slenderest nerve fibers, even though they are too thin to be hollow, and do not support any extension of the path.

At this point very many people raise their voices in inquiry and dispute whether the actual substance of animal spirit, in setting movement or sensation going, makes its way into the nerves. It is certainly clear that it flows as far as there is a visible cavity in the cord and the nerves, and everyone clearly agrees on that too. But that it penetrates further into the remaining parts, only a few people have convinced themselves. Why? “Because,” they say, “they are not hollowed out.” It is as if spirit, extremely rarefied, needed everywhere an open trough, and could not slip in gradually to irrigate the nerves. If the nutriment that nourishes the nerves worms its way into their substance, if thick sluggish humor does, if fatty oil, dripped on, sinks right into them, what reason is there why animal spirit, that rarefied and ethereal stuff, cannot pervade the whole of their substance in every direction? Our senses judge that it slides into the optic nerves of the eyes, into the cavity of the spinal cord, and into the origins of nerves; in the same way, the weight of reasoning here establishes that it also extends into the rest of [P143] their substance; and what is more, that it is hardly comprehensible how a rational distribution of powers and faculty can occur without spirit to carry them. When vital spirit is converted to animal spirit, it

à cerebro eíusque meningibus nouam speciem, et vires nouas assumit asciscí-
tque sibi: quas demum tanquam actionum opifices in neruos sentientes, tan-
gentes, ac mouentes secum provehit. In his autem semper praesens adest,
quoniam iugis illa quam commemorauí cerebri agitatio, eum assiduè profundit
atque distribuit. Quanquam verò semper in neruis dum sani sunt spiritus hic
adest, non tamen necessariò motum efficit, sed neruorum duntaxat et mus-
culorum robur et firmitudinem tuetur ac continet. Quidnam ergo aliud praeter
hunc spiritum, motionem sensúmque conferet? éstne hoc ipso quicquam prae-
stantiús? Explicandum hoc planiús et fusiús est. Sensuum instrumenta neruíque
omnes et muscoli, spirituum viriúmque animalium continenti illapsu et aspira-
tione firmantur, simúlque stabilimen et praeparationem quandam ad obeunda
munia assumunt: hoc certè argumento quòd praepeditis et obstructione quad-
am interceptis viis, velut in paralyssi, non modò sentiendi aut mouendi spes
adimitur, sed omni prorsus robore dissoluto languescunt. Dum verò accepto
spiritu omnia suo robore constabunt, benè instructa et composita erunt ad opus,
et tum integrè functiones suas obibunt: sed modo planè diuerso. Sensus enim
externus perperessione quadam percipit, quum subiectarum rerum incidentibus
qualitatibus mutatur et afficitur. Non sic autem motus, sed sola actione is
perficitur, nulla re extrinsecus irruente: quum primum enim appetitus aut
voluntas mouenti facultati per neruos et musculos cum spiritu diffusae imper-
auerit, in quancumque illa partem intenderit, continuò illius mouens facultas
concita motum exercet et imperio paret. Est quandoque hoc voluntatis imper-
ium, promptum quidem et euidens, sed plerunque obscurum vsque adeò ac
tenue, vt nos prorsum fugiat, velut in oculorum et palpebrarum motu, in
plerisque tum capitis, tum manuum gestibus, in dormientium respirationibus et
corporis iactationibus, ad quas nihil aut minimum intenti videmur. At quum
paralysis artus occupat, quia tum nerui à spiritu et facultate destituti sunt, nulla
vel efficacissima voluntas motum potest efficere. Ex quibus intelligi potest
praecipuam motus causam ad spiritum et facultatem potius quàm ad appetitum
pertinere, illúcque refundi: et praeter appetitum seu voluntatem, aliam propin-
quorem atque coniunctiorem motus causam haberi. Hoc porrò voluntatis
imperium parum omnino efficax videbitur, nisi conatus quidam et intentio
animi tanquam comes accedat. Non enim si quis velit aut oculos in diuersa
contorquere, aut omnes simul partes motibus impellere, aut sensibus omnibus
pariter et perfectè quippiam percipere, omnia statim efficiat,

acquires for itself from the brain and the cerebral meninges a new form and new powers; these it carries forth with it in the end into the nerves of sensation, touch, and movement, as fashioners of actions. It is always present in them, since that unending motion of the brain I mentioned emits and distributes it continually. Although this spirit is ever-present in the nerves while they are healthy, it does not necessarily bring about movement, but just guards and sustains the solid strength of the nerves and muscles. Then what, apart from this spirit, will contribute movement and sense? Is there anything surpassing this very thing? This needs fuller and longer explanation. The instruments of the senses, and all the nerves and muscles, are reinforced by the continuous inflow and exhalation of animal spirits and powers, and at the same time they possess themselves of support and some preparation for discharging their tasks; the evidence is surely that when the pathways are obstructed and cut off by a block, as happens in paralysis, not only is hope of sensation or movement taken away, but they [the patients, presumably] flag, all their strength completely undone. But after receiving spirit, everything will stand firm and be well-ordered for its work, and will then discharge its functions faultlessly, but in a quite different fashion. For external sense perceives in a passive fashion, on being altered and influenced by the impact of the qualities of subjects.

Movement is not brought about like this, but only by action, without the intrusion of anything external. As soon as appetite or will has given the command to the faculty of movement, a faculty that is diffused throughout the nerves and muscles along with spirit, whatever the part is to which appetite or will [presumably] points, its moving faculty is aroused at once and sets movement going, in obedience to the command. At times this command of the will is obvious, but usually is so imperceptible and rarefied that it escapes us altogether, as in the movement of the eyes and eyelids, in most of the gestures of the head and hands, in the breathing and body jerks of sleepers, to which we seem to pay no attention, or very little. But when paralysis takes over the limbs, the nerves are deprived then of spirit and faculty, so that not even the most effective wish can bring about movement. It follows that the paramount cause of movement rests with spirit and faculty rather than with appetite, and is restored to there; and that there exists another and a more closely linked cause of motion, in addition to appetite or will. Further, altogether too little efficacy is going to appear in this command of the will, unless some effort and concentration of the mind accompanies it. If anyone wishes either to twist his [two] eyes in different directions, or to throw all his parts into motion together, or to perceive something with all his senses alike and completely, he may not achieve it all without

etiam si bene valeant, et integra sint instrumenta. Cuius sanè haec vnica est causa, quòd non potest animus omnia simul animaduertere, neque esse ad singula intentus. Ergo non sola voluntas satis est, sed animi quaedam est intentio necessaria, quae facultatem in particula alioqui sopitam et languidam concitet in opus. Haec autem facultas animalis quae vectore spiritu in quancunque particulam per neruum influxit à cerebro, dum voluntatis imperio et animi conatu intentioneque pulsabitur, motum faciet: primùmque dum neruum ac musculum contendet, et in seipsum firmiùs contrahet, simul eam particulam adducet, in quam inseritur, siue os est, siue membrana. Dum enim facultas musculum intendit et contrahit, simul et os mouet in cuius caput inseritur, et totum membrum cuius id fundamentum est. Ergo contentio ea et contractio propria musculi est functio, extensio autem et relaxatio ceu remissio quaedam est: haec autem oppositorum musculorum est contentio. Laborat musculus quoties impendiò aut contrahitur, aut extenditur: neque membrum citra laborem et defatigationem diu multùmque extendi potest aut contrahi. Ea autem duntaxat figura et constitutio quae inter extremas exquisitè media sit, et in qua musculi omnes quasi dissoluti cessant, prorsus lassitudinis et doloris est expers. Quocirca dum vehementer tensum aut contractum membrum est, vt in brachij porrectione, licet id tum fortasse fixum sit, nec de loco aut statione sua decedat, moueri tamen dicimus, qnatenus [*sic*] laborat et operatur, idque frequen-[P144]tius cum dolore. Quinetiam quae media figura dicitur, si cum intentione omnium musculorum immobilis continebitur, quia tamen ad postremum, laborem affert, in quiete non est, sed motu et labore concutitur. Eiusmodi motus est, qui tonicus appellari solet, ei similis quo auis alarum nisu vno eodémque loco quasi subnixa se diutius immobilem sustentat.

De mentis functionibus. Cap. XIII.

EIUS PARTIS animae quae rationis atque consilij particeps est, sic omnes intus abditae functiones delitescunt, vt nunquam foras et in apertum se dent, neque vllius illa aut externi aut interioris instrumenti egeat subsidio: sed quum sit omnis expers materiae, in eas duntaxat res incumbit, quae neque in materia subsistunt. Subiecta enim illi sunt ea rerum simulachra, quae suprà dixi in principe sensu conseruari, et quae verae sunt rerum notiones perceptae sensibus. Hae quidem in mentem et intelligentiam altiùs penetrare non possunt, quia tametsi

delay, even if the instruments are healthy and intact. For this there is certainly a single cause: that the mind ["animus"] cannot pay heed to everything at once, nor attend to individual details. Therefore will is not enough on its own; some concentration of the mind ["animus"] is necessary, to stir a faculty to its work that would otherwise be slumbering and sluggish in the part. This animal faculty will bring about a movement; it flowed into any part along a nerve from the brain, carried by spirit, when it is assailed by the will's command and the mind's effort and concentration. And first, it will tauten nerve and muscle, and draw [them] more strongly into itself, and pull simultaneously upon the small part into which it is implanted, whether bone or membrane. While the faculty points at and contracts a muscle, simultaneously it [probably the muscle] moves the bone into whose head it is inserted, and the whole limb whose foundation it [the bone, probably] is. So this tensing and contracting is the specific function of muscle, while extending and relaxing is a sort of release; and it is the tensing of the opposite muscles. A muscle exerts itself every time it contracts or is extended a great deal, and a limb cannot be extended or contracted long and much without exertion and fatigue. Only a shape and state precisely in the middle between their extremes, one in which all muscles idle as if in slackness, is entirely free from weariness and pain. Consequently, during vigorous tautening or contraction of a limb, as in stretching out an arm, even one that happens to be fixed in position at the time and does not depart from its posture, we still say we are on the move, to the extent that it labors and is at work, and [P144] quite often in pain too. Furthermore, the so-called middle shape is not at rest, but is aroused by motion and exertion, if it is held immobile with tautening of all the muscles, because in the end it is still contributing exertion. This is the sort of motion usually called tonic, and is like the effort of its wings by which a bird supports itself for some time stationary in one and the same place, as if propped up.

Chapter 14. The functions of the mind.

ALL THE functions of the part of the soul that has a share of reason lie low in concealment inside, in such a way as never to appear outside, and this part has no need of the help of any instrument, external or internal. But since it is free of all material, it applies itself just to things that are not in material either. Its subjects are those images of things that I mentioned previously were preserved in the main sense, and that are the real concepts perceived by the senses. They cannot penetrate more deeply into the mind and intelligence, since even though

sine corpore sunt, materiae tamen impurum quiddam redolent: sed mens quae ex duplici intelligentia tum agente, tum patiente condita est, dum illas agentis vi et impulsu contuetur, puras, indiuiduas atque simplices ex iis rerum singularum notiones elicit, quas dein patiens intelligentia continet atque seruat. Non sunt hae quidem simulachra atque spectra rerum externarum, sed aliae quaedam ex his tractae atque conceptae animi notiones: est enim notio, actus mentis et animi è subiecto simulachro ductus. Itaque agens intelligentia tanquam architectus quidam et fabricator est notionum: has autem omni materia liberas et exutas suscipit, et continet patiens intelligentia: neque tamen ab eis quicquam patitur, sed in earum materiam quodammodo transit. Haec igitur quia rerum omnium notiones erat acceptura, omnium capax formarum, peculiarem nullam formam obtinuit, ne haec vna caeteris formis tanquam peregrinis et aduentitiis aditum intercluderet. Hinc rectè animam seu mentem formarum omnium praestantissimam atque summam appellauerunt, quòd vna reliquas omnes cernat atque percipiat. Caeterum non in illis duntaxat singulis versatur et consistit, sed in notionum quasi syluam ingressa, ex singulis vniuersales quasdam colligit: neque ex his modò, sed è singulis etiam rebus quae nobis obuersantur, vniuersales formas à materia diuellit et exuit, propriamque essentiam ab ipsis quibusque rebus discernit. Ea est simplicium notionum tum singularum tum vniuersalium ratio, in quibus veritas aut falsitas nulla versatur. Ad has porrò quum mens componendi facultatem adhibebit, temporis copulatione interiecta, plurima aptè componet, in quibus veritas aut falsitas iam est. Deinde verò de compositis istis planum iudicium proferet, hoc aiens bonum esse, illud inficians esse honestum: in quibus vt quaedam rectè diiudicat, sic plerunque dum distorta et falsa pro veris sumuntur, iudicij error incidit. Hanc vt iudicandi ita discernendi functionem possis appellare, sed quae tamen multò sit ea praestantior, quàm communis sensus proferebat. Mens porrò se ad ratiocinandum erigens et excitans, ex illis plurima admirabili eoque libero contextu complectitur et colligit, aut inductione aut argumentatione. Nam ex singulis primùm tanquam ex quibusdam exemplis vniuersalia inducit theoremata, communésque rerum et generum summas. Ex his deinde argumentatione plurima comparat, de quibus scientia habetur vel opinio. Si ex necessariis principiis atque theorematis argumentum concluditur, scientia fit, quae ipsa necessariorum duntaxat et aeternorum est: sin verò

they are incorporeal, they do still have an unsavory flavor of material; but the mind, being composed of twofold intelligence, both active and passive, draws forth pure, inseparable and simple concepts of individual things while gazing at them with the power and prompting of the active intelligence; the passive intelligence then encloses and preserves them. These are not images and specters of external things, but other concepts of the mind derived from these; a concept is an action of mind [*"mentis et animi"*] drawn from the underlying image.

And so the active intelligence is a sort of architect and fashioner of concepts, and the passive intelligence takes them up free and stripped of all material, and holds onto them. It is not affected by them in any way, but passes across into their material in some way. Since it was going to receive concepts of everything, being able to accommodate all forms, it took up no special form, in case that one [*"haec vna"*] blocked entry for the rest of the forms, making strangers and aliens of them. Hence people have been right to call the soul or mind the most outstanding and highest of all forms, because it alone views and perceives all the rest. But it does not concern itself with and dwell on these single concepts alone; entering, so to speak, the wood of concepts, it picks some universal ones from the individuals; and not out of these alone, but also out of individual things that appear before us, it tears off and strips universal forms from material, and separates particular essence from all the things themselves. This is the basis of simple concepts both individual and universal, in which no truth nor falsity is involved. Further, when the mind applies to them its faculty of organizing [*"componendi"*], it will insert a link to time, and organize many things suitably, in which now there is truth or falsity.

Next, it will present clear judgment on these organized things, asserting that one of them is good, denying that another is honorable. In these cases it makes some correct decisions, yet often, the distorted and false being taken as true, an error of judgment develops. This function can be called the function of judging or of discriminating, but much surpassing it is the one that the general sense was displaying. Besides, rousing itself for reasoning, the mind clasps and gathers very many of these [evidently the decisions] on a remarkable unrestrained scheme, either by induction or by evaluation [*"argumentatio"*]. It starts by inducing universal theorems from individual cases as examples, and general gists of things and kinds [*"generum"*]. Then by evaluation it compares many of these on which knowledge or opinion exists. If the evaluation is brought to a close from the necessary starting points and theorems, knowledge is created, whose own scope is limited to necessary and eternal things; but evaluation from

ex probabilibus, opinio. His iam partis interdum mens et intelligentia nostra non vltra progreditur, sed infixā in eorum contemplationem, illic tanquam in extremo consistit, quid in illis verum falsumve sit perspicuens, his saturata bonarum cogitationum epulis. Ea est quam contemplantem intelligentiam appellant, quae maximè et duntaxat circa res est vniuersales, necessarias et sempiternas, quae eadem admirandae sunt difficiles atque diuinae. Habitus quo haec efficit et facultas sapientia est, eiusque functio studium est sapientiae, quod qui colunt sapientes appellantur, quoniam propria commoda negligentes, aeternorum contemplatione viuunt. At verò quum mens intelligentiāque [P145] nostra in rerum caducarum et fortuitarum cognitionem consequutione quadam et progressionē adducetur, si in illis non prorsus inhaerescat, neque illarum contemplatione tota teneatur: sed iam cognitum habens et compertum illas posse mutationem subire, quaerat et inuestiget, moliatūque ad quandam hominum commoditatem et vsum illa referre, tum sanè practica erit intelligentia, quae tota in actione versatur, omnesque ratiocinandi progressus in hominum commoda tanquam in finem supremum dirigit. Vt autem hominum bona, alia praestantiora sunt, vt rei domesticae aut publicae administratio, alia his viliora: ita vis intelligens in illa aliter atque in haec incumbit. Nam prudentiae facultate, praestantiora illa tractat, et in hominum commoda fructusque refert. Quae quoniam commutabilia sunt et opinione dubia, de illis consilium captat, consultat, deliberat. Atque si non hebes est, sed sagacitate pollens ac solertia (quae perspicax quaedam est prudentia) boni atque honesti desiderio tenetur, non festinanter et citò quasi auguratione quadam, sed recta ratiocinatione et inuestigatione accurata multo maturòque tempore, quodcunque bonum in consultationem positum est, assequitur: atque ea bona est consultatio ex prudenti sagacitate genita, mala verò consultatio si quid horum econtrariò accadat. Qui ad bene consultandum aptus idoneusque fuerit, quo aut publica bona, aut priuata augeat atque moderetur, is omnino prudens censebitur: contrā [sic] verò imprudens, qui non poterit recto consilio bonum finem prospicere atque consequi. Caeterum quum agens illa practicaque intelligentia, quae conceperit noueritque theoremata, non ad bene beatèque viuendum, sed ad vilius quoddam opus et artificium refert: hoc si bono consilio et maturo rectaque ratione facit, arte quidem facit: quae ipsa certam rationem atque viam praebet operis faciendi. Quid demum consequitur? Vbi practica intelligentia prudentiae bona consultatione hoc illudve agendum esse deliberauerit, quia bonum et vtile: aut

probable things leads to opinion. Our mind and intelligence sometimes advance no further from these gains, but, engrossed in their contemplation, makes that point its terminus, discerning what is true or false in them, sated with this feast of sound reflections. This is what is called the contemplative intelligence, which is mainly and precisely concerned with universal, necessary and eternal things, which are also marvelous, difficult, and divine. The attitude and faculty by which it does this is wisdom, and its function is the pursuit of wisdom; those who cultivate this pursuit are called the wise, as they spend their lives in the contemplation of eternal matters, ignoring their own advantage.

But there will be times when [P145] our mind and intelligence are drawn by some sequence towards investigation of ephemeral and haphazard things; suppose that it is not entirely attached to them nor totally taken up with their contemplation; and suppose too that, being acquainted with their ability to undergo change, it pursues inquiry and strives to direct them towards some human advantage. At such times, the intelligence that is all concerned with action, and turns all the advances of reasoning towards human advantage as their highest aim, will be indeed effective.³³ Among human boons, some are more excellent, like the administration of private or public affairs, and others more ordinary; so the intelligent power devotes itself in different fashion to the two: it conducts the more excellent matters with the faculty of prudence, and directs them to human benefit and profit; since they are labile and open to differing opinion, it takes counsel, consults, and ponders over them. And if it is not dull-witted, but laden with flair and ingenuity (which is a perspicacious sort of prudence), and possessed with longing for what is good and honorable, it pursues any good that is there for discussion, not precipitately as if taking the auspices, but with correct reasoning, searching investigation, and ample and ripe ["maturus"] time; sound debate is born of prudent flair, but unsound debate is when something opposite occurs. The man who has been suited to good consultation, through which he can increase and control either public or private advantages, will be regarded as totally prudent; on the other side is the imprudent man, who will be incapable of using sound counsel to foresee and pursue a good purpose.

But suppose that this active and effective intelligence, which has perceived and recognized theorems, does not turn to living well and happily, but to some more ordinary handiwork; if it follows a good and ripe plan, with sound reason, it is employing skill. Skill itself offers a definite plan and method for carrying out a task. What ensues then? When the effective intelligence, upon due and prudent debate, is resolved on doing this or that, as good and useful; or else

vbi artis bono consilio statuerit opus quoddam subeundum faciendúmque, quia item vtile: tum sanè rationis participem appetitum mouet allicitque. Is demum quicquid bonum existimatum est eligit, idque non simplici et pura voluntate, sed ea quae bono consilio et deliberatione confirmata est. Haec autem tantae est efficacitatis, vt quaecunque bonorum specie agenda faciendáue selegerit, illa mox persequatur et perficiat, et idcirco vna videri possit omnis actionis effectiónisve causa atque principium: contrà si quicquam reiecerit tanquam noxium et infestum, mox illius fugam arripiat. Ergo dum quippiam nobis occurrit quod arrideat et iucundum sit, si continuò vt pecudes illius lenocinio, nulla deliberatione praegressa trahimur, simplex ea voluntas est, quae si incontinentes sumus, saepius à bruto appetitu praeualente lacessitur et euincitur. At verò si consultatione adhibita nectemus multa et conferemus inuicem, ex quibus colligimus, si hoc aut si illud fiat, mala multa impendere, tum sanè id effugimus et declinamus, quod primùm oblectamenti speciem prae se ferebat. Hae sunt omnes intelligentis animae mentisque functiones, ad earum imitationem explicatae, quas sentiens anima protulerat. Quid omnes dico, nónne insuper illa tum meminit tum reminiscitur? Meminit illa quidem, atque ad vsum memoriae eas quoque vniuersales notiones reuocat, quae intelligentia mentéque capiuntur. Nulla quidem generum aut formarum haberi possunt spectra et simulachra, quae in mente aut in communi sensu quasi sopita seruentur, et quae aliquando posthac mentem ipsam et intelligentiam denuo concitent: sed à generibus atque formis solùm notiones emergunt, quae semper intelligentiam mouent et impellunt, et quae in sola mentis contentione consistunt. At simulachra, vt quae ab indiuiduis duntaxat eliciuntur, omni animae conatu actionéque sedata et prorsum anima quiescente seruantur. Sic autem mens et intelligentia meminit. Quum notiones illae generum aliquando disperditae euanuerint, singulorum simulachra ex quibus illae haustae conceptaeque fuerant, et quae sensus communis retinet, rursus intelligentiam incitabunt et impellent, ex quibus illa similes atque olim generum notiones eliciet. Hae dum in mentem veniunt, si praeteriti temporis ratione suscepta, mens pariter sentit se illas prius tenuisse atque nouisse, id profectò est intelligentiae memoria. Quocirca mens aut intelligentia non per se atque primùm meminit, sed principis sensus interuentu atque auxilio: in quo, vt inquit Aristoteles, memoria per se et primò inest, non sic autem in mente. Quandiu itaque constans et di-[P146] lucidum erit externae rei simulachrum, id è principe sensu mentem impellens,

when, by sound assessment of skill, it has determined that some task is to be undertaken or carried out, as useful too; then surely it sets in motion and entices the appetite that shares in reason. This is what selects anything that is reckoned good, and not just out of a wish pure and simple, but out of a wish reinforced by sound consideration, which is so effective that it soon pursues and performs anything it has chosen to achieve in the form of advantages, and that consequently it can be seen as the sole cause and origin of every action or effect. On the other hand, if there is anything it has rejected as injurious, it soon undertakes its exile. Therefore, when we encounter anything of a sort to be pleasing, and ["si"] we stray after it at once like sheep, and fail to think first, this is a simple wish, which (if we lack restraint) is quite often harassed and overpowered by the brute appetite.

But, if we employ deliberation, and link and compare together many possibilities, deducing that if one or the other occurs, much evil looms; then indeed we make our escape from the form of attraction it was displaying at the start. These are all the functions of the intelligent soul and mind, set out after the pattern of those the sentient soul had displayed. What made me say "all"? Surely she both remembers and recalls in addition? Yes, she remembers, and for memory's use summons back also those universal concepts that are grasped by the intelligence and mind. These cannot be regarded as specters and phantoms of kinds or of forms, to be kept (so to speak) asleep in the mind or the general sense, and sometimes to disturb the mind and intelligence again later on; no, they arise from kinds and forms as concepts alone, which always set the intelligence in motion, and exist in mental tautness ["contentio mentis"] only. But as phantoms are summoned out by individual things only, they are preserved when every effort and activity of the soul is soothed and the soul is at complete rest. This is the way in which mind and intelligence remember. Sometimes, when these concepts of kinds have vanished into nothing, phantoms of particular things from which the concepts had been derived are retained by the general sense, and will again stimulate the intelligence, which will draw from them concepts of kinds, similar to the previous concepts. When these are entering the mind, then if the mind has adopted a basis of past time, and detects simultaneously that it has contained and known them previously, that is undoubtedly what intelligence's memory is. Therefore mind or intelligence does not remember on its own and from the start, but through the helpful intervention of the main sense; memory, as Aristotle says, in itself and primarily resides in that sense, but not in mind in the same way.³⁴ And so, as long as the phantom of an external thing continues [P146] clear, through its impact from the main

memoriam rei à qua ductum est poterit excitare. Quòd si non vniuersum id retinebitur, sed vel temporis diurnitate, vel morbo, vel alia quauis iniuria pars deleta est, pars verò tam pusilla reliqua est, vt neque animum ciere, neque rem externam repraesentare integrè possit: tum profectò illius periisse memoriam dicemus. Caeterum si pusilla ea pars tanquam origo et seminarium quoddam poterit vel minimum excitare et proritare, haec confestim contextu et serie in proximum et affine quippiam migrabit, mox in tertium, deinde in aliud, donec admirabili rerum continuatione et serie pristinam cognitionem capiat. Hoc quidem modo mens reminiscitur, ipsaque illius actio recordatio est, collapsae memoriae reuocatio. Haec idcirco non beluarum, sed solius est hominis, quòd non nisi connexionem rerum et ratiocinationem quadam comparetur. Neque etiam beluis propriè inest memoria, quòd praeteriti et futuri temporis perceptionem nullam habent, sine qua meminisse non possumus. Quae bona aut mala iam saepius senserunt, agnoscunt illae quidem, sed tanquam praesentia sint, nulla elapsi temporis obseruatione. Neque enim apes neque formicae, quae alimenta sibi in hyemem recondere putantur, in futurum prospiciunt, verùm ea solius est naturae quaedam inconsiderata nec praemeditata molitio. Mortuis nobis statim omnium rerum quas in vita cognouimus memoria deletur: quoniam haec ex communi sensu pendebat, qui ipse patibilis est, et pereuntibus nobis simul occidit: quare ab illo seiuncta mens immortalis, illiusque subsidio destituta praeteritorum meminisse non potest. Est vbi Aristoteles communem sensum fusa nominis appellatione intelligentiam appellat, eamque patibilem et quae in nihilum occidat. Non recordamur (inquit) ab occasu, quia intelligentia quae patibilis est extinguitur, sine hac autem nihil intelligit separata illa mens impatibilis et immortalis. Idem alio loco, Amare, odisse, affectiones continentis, non illius sunt quatenus ipse est: quapropter continente corrupto neque meminit, neque amat, quia non erant illius haec, sed communis quod iam periit. Mens illa et simplex nostra intelligentia quum è corpore discesserit, patiendi ratione deperdita, alteram duntaxat agendi vim conseruabit. Non enim tum ea sensuum ministerio indigebit, neque ab his haustas rerum notiones suscipiet quibus cognoscat: sed ipsa per se omnia spectans nihil aliud quàm merus erit actus, à sua simplici natura id obtinens, vt tum se aliàque intelligat, tum intelligatur à se. Ea neque componit quicquam aut diuidit, neque vlla connexionem ad rerum cognitionem accedit, sed formas rerum omnium in se continens,

3. de Anima

1. de Anima

sense on the mind it will be able to stimulate the memory of the thing from which it was drawn. If it is not wholly retained, but a part is abolished through lapse of time, or disease, or any other impairment, yet the part remaining is too tiny to be capable of rousing the mind ["animus"] or of faithfully reproducing the external thing, then we shall surely say that its memory has perished.

But if this tiny part proves able to serve as a starting point or nursery [of young trees], and to do even a little stimulation, it will instantly shift to something akin and next in sequence, then into a third, finally into another, until it picks up the original knowledge by a remarkable series of things. This is the way the mind recollects, and the action it performs is recollection, the recalling of a lost memory. Beasts therefore cannot do this, only man, because it is forthcoming only with linking between things and some reasoning. Also, memory in its proper meaning is not present in beasts, because they have no perception of past and future time, a perception necessary for memory. Any good or evil they have come to feel quite often, they do recognize, but as if in the present, without taking note of past time. Bees and ants, which are thought to store up their food for the winter, do not look ahead to the future; this is an unplanned effort of nature alone, without premeditation. When we die, the memory of all we knew in life is canceled at once, because it used to depend on the general sense, which is itself vulnerable ["patibilem"], and perishes at the time we do. Consequently the immortal mind is separate from it, and without its aid is incapable of remembering the past. There is a place where Aristotle calls the general sense, in a wide use of the name, "intelligence," saying that it is vulnerable ["patibilem"], a thing that can pass away into nothing. "After death," he says, "we do not remember, because the vulnerable intelligence is annihilated, and without it the mind on its own, immortal and beyond experiencing anything ["impatibilis"], understands nothing." Elsewhere he says, "Loving and hating are experiences of what contains, not of the mind so far as it is itself; consequently if what contains is spoiled, the mind neither remembers nor loves, because these were not features of it, but of the general mind that has already perished." When that mind and the simple intelligence of ours have departed the body, with the basis of experience gone, it³⁵ will preserve just the other power of acting. At that time it will have no need of the services of the senses, nor receive concepts of things drawn from them to learn from; but, itself surveying everything on its own, will be simply pure action, from its own nature succeeding both in understanding itself and other things, and in being understood by itself. It does not assemble or divide anything, and does not attain knowledge of things through any association, but holding within itself the

vna comprehensione simul aggreditur et intelligit omnia. Vnde semper intelligit et intelligitur à se, nunquam defatigatione ingrauescit, tota aeterna et immortalis.

Principes animae facultates non esse sedibus distinctas. Cap. XV.⁷

LIBERANDA HÎC postremò fides est quam suprà dedimus, dum quaestionem illam explicare sumus polliciti, nunquid fingendi, ratiocinandi, et memorandi functiones discretæ sic habeantur, vt vnaquaelibet laedi deprauarique possit, aliis ne vel minimùm quidem offensis. Id quidem omnino fieri posse quamplurimi sibi persuaserunt, simplici quadam ratione eaque non planè comprehensa. Aiunt enim eos qui febre iactantur, nonnunquam floccos et paleas euellere, monstrosa visa obuersari, essèque in his simulachrorum comprehensionem, ipsámque fictricem facultatem offensam constante ratione ac iudicio, quo haec plerunque agnoscunt ac iudicant falsa esse ac mendacia, quemadmodum et dormientes quæ vident in somnis, saepe iudicant non vera illa, sed commenta somniorum esse. In his igitur laesa est confictio et phantasia, salua et constante tum ratiocinatione tum memoria. Alij in delirio peruersè iudicant et ratiocinantur, qui tamen et familiares, et quaecunque obuersantur agnoscunt, satisque praeteritorum meminerunt: in quibus constat rationem turbari reliquis duabus illaesis. Ex his statim concludunt isthaec obueneri non posse, nisi quæ effectrices earum sunt facultates locis sedibúsque disiungantur. Quum firmissima sit haec eorum ratio, experiamur, si possimus eius cornua summouere, vt hac minuta controuersia [P147] quid lateat veritatis fiat perspicuum. Philosophorum id quorundam autoritate celebrari video, similem imò et eandem animæ essentiam cunctis inesse hominibus, neque in hoc quàm in alio vspiam perfectiorem inueniri, quòd omnino simplex et indiuidua sit, cui nihil addi minuive potest, quin speciem mutet. At nihilominus simplex illa in hoc quàm in alio facultates exhibet perfectiores, et aliàs expeditiùs, aliàs segniùs functiones edit. Ita quippe alios natura animaduertimus cogitatione et ingenio valere, quibus infirma est memoria atque ratiocinatio: alios tum rerum tum literarum memoria praestare, quibus nihil aut minimum sit rationis ac iudicij: alios solido ac bene naturali esse iudicio, quorum non aequè prompta sit cogitatio, aut firma memoria. Has

forms of everything, it addresses and understands everything at once in a single grasp. Hence it forever understands, and is understood by itself, never weighed down by weariness, wholly eternal and immortal.

Chapter 15. The main faculties of the soul are not separate in their seats.

AT THIS point we must finally discharge the undertaking we gave previously, in promising to give an account of the question whether the functions of simulating, reasoning, and remembering are so separate that any one of them can be damaged or perverted, but the others come to not the least harm. Very many people have convinced themselves that this is perfectly possible, on some simple theory and one not fully grasped: they say that those who are tossed about by fever sometimes tear out wisps of wool and husks of corn; that monstrosities seem to appear before them; that a grasp of phantoms is present in them; that the actual simulating faculty is resentful at the presence of reason and judgment, which often enable them to recognize these appearances as deceitful and lying, in the way that sleepers also frequently recognize that what they see during sleep is not real, but the fabrications of dreams. So in these sleepers invention and fantasy are impaired, but both reasoning and memory are kept safe. Some victims of delirium judge and reason erroneously, yet can recognize their intimates and anything that passes before them, and remember the past adequately; it is accepted that in them reason is in disorder but the remaining two are intact. From this they conclude at once that these things are possible only if the faculties that bring them about are detached from their seats. This theory of theirs is very robust, but let us see whether we can push away its horns, to let the [P147] hidden truth appear clearly through this subtle argument. I notice that it is announced on the authority of certain philosophers that a similar, nay, the same essence of the soul resides in every man, and a more perfect one is nowhere to be found in one man than in another, as it is entirely simple and indivisible, and nothing can be added to it or taken from it without changing its form. Just the same, this simple essence displays more perfect faculties in one man than in another, and sometimes discharges its functions more speedily and at other times more sluggishly. Thus we observe some people of strong natural thinking power and talent, whose memory and reasoning is weak; others excel in their memory both of things and of literary works who have no, or very little, reason and judgment; others are of solid sound natural judgment, yet their thinking is not so ready nor their memory strong. These

autem facultates varias efficit, non animae essentia, sed corporis et instrumentorum eius varia constitutio, ex temperamento et conformatione contracta: horum quippe conditionem animae facultates atque mores sequuntur. Neque verò insita solum et congenita nobis, sed et adscititia constitutio animi facultates morésque mutat: et corpore puro omnique sorde vacuo candidi sunt mores vegetaeque animi vires: impuro autem et sordibus inquinato perturbati mores et hebetes vires animi. Quòd tam multa támque varia sint hominum ingenia, támque dispares eorum mores, alij sobrio, alij vinoso, non aliunde petendum, quàm ex corporis aut naturali aut adscititia constitutione. Iam verò si corpus grauiùs morbo conflictabitur, quis dubitet occupata impeditave animi sede illius vires grauiter aut impediri aut perturbari? Si corpus spiritùsque vehementer concutitur, vt in febrium ardoribus, mens constare non potest, sed concita turbido motu commouetur. Sin verò corpus morbo prosternitur, animae vires pariter elanguescunt, neque laboranti integrae possunt consistere. His ita ad rem subiectam constitutis non difficilè sit aduersariorum rationes diluere. Dum anima turbulentis ita causis concutitur, ipsi quidem fatemur non protinus omnes peraequè illius facultates offendi. An idcirco necessum videtur sedibus illas discludere? Minimè. Vndénam igitur haec affectionum varietas? Quaecunque facultas natura aut vitio infirma existit, irruentibus causis minus obsistit promptiùsque offenditur: quae verò firma est ac valida, minus offensionis et iacturae suscipit. Quum itaque leuior erit delirij perturbatio, cui comprehensio fictiòve infirma erat, is sola comprehensione delirabit, multaque aliena cogitatione finget: cui verò iudicium inualidum fuerat et imbecillum, is duntaxat praeposterè iudicabit et ratiocinabitur. Quum autem vehemens incidet delirij perturbatio, omnes pariter principes facultates peruertentur, aliàs pari iactura, aliàs dispari. Non absimilis est in caeteris facultatibus ratio: quum enim in illas aduersa vis peraequè irruet, imbecillior quidem prosternetur, validior obsistet irruenti iniuriae, etiam si eadem sede consistent. Itaque ex leuibus assumptionibus nec planè cognitis rationem suam conclusère, qui cogitationem, ratiocinationem, ac memoriam sedibus atque instrumentis seiunxerunt. Indignum erat Philosophi grauitate atque constantia, quod non satis exploratè perceptum fuerat et cognitum sine vlla dubitatione confirmare. De animalibus functionibus haec tradidisse satis, nunc de vitalibus, quibus pulsus et respiratio assident.

varied faculties are the work, not of the essence of the mind, but of the differing constitution of the body and its instruments, induced by the temperament and [outward] appearance, the state of which determines the faculties and practices of the mind. It is not just the resident and congenital constitution of the mind, but also the adopted one that alters faculties and practices; in a pure body, free of all squalor, the practices are innocent and the mind's powers vigorous; but in an impure one, fouled with squalor, the practices are disordered and the mind's powers blunted. Human talents are so many and so diverse, and their practices so varied, some sober, others too fond of wine [syntax anomalous]; the explanation is to be sought simply in the natural or adopted bodily constitution. Now, if the body is rather seriously distressed by disease, can anyone doubt that with the mind's seat invaded or obstructed, its powers are either severely obstructed or severely disordered? If body and spirit are strongly distressed, as in accesses of fever, the mind cannot stand firm, but is agitated by confused movement. And if the body is stricken down by disease, the soul's powers flag as much, and cannot stay intact while the body struggles.

With these points contributed to the subject, it may not be hard to rebut the reasoning of our antagonists. When the soul is thus distressed by disorderly causes, we ourselves accept that not all its faculties are directly impaired to the same extent. Does this make it seem necessary to exclude them from their seats? Not at all. What then is the origin of these differing effects on them? Any faculty that proves weak by nature or defect resists the intrusion of causes less, and is more readily impaired. But one that is strong undergoes less impairment and damage. And so, when a delirious disturbance is slighter, in someone whose grasp or imagination ["fictio"] was weak, he will be delirious in his grasp alone, and will imagine many unusual things; but someone who had feeble judgment will simply judge and reason incoherently. When, however, the delirious disturbance has a powerful impact, all the main faculties will be corrupted together, sometimes with equal disaster, sometimes not. The situation in the rest of the faculties is similar: when a hostile power encroaches upon them equally, the weaker one will be stricken down, the stronger one will resist the encroachment, even if the two exist in the same seat. And so those who supposed separate seats and instruments for knowing, reasoning, and remembering drew their conclusion from slender and ill-understood assumptions; it was unworthy of serious and consistent philosophy to assert without any hesitation something not sufficiently searchingly apprehended and considered. I have conveyed enough about the animal functions; now for the vital functions, to which pulse and breathing are closely relevant ["assident"].

Calorem nostrum perpetuò refrigeratione, pabulo, et expurgatione indigere, alioqui extingui ipsum et extabescere. Cap. XVI.

SIC EXIMIA et illustris illa rerum natura tulit, vt omnia quae aluntur et quae crescunt, contineant in se vim caloris, sine qua neque ali possent neque crescere: inter haec verò animantes, quarum quàm stirpium perfectius erat vitae genus futurum, vberiore hunc acceperunt, cuius nimirum temperatione vitae status omnis conseruaretur. Rursum in animantibus quaecunque sanguine praeditae sunt, hoc ipso ampliùs circumfluunt et abundant, quàm quae sanguinis sunt expertes. Hic autem noster calor quanquam aethereus, frigidi tamen aëris appulsum continenter desiderat, cuius defectione mox prorsus extinguitur. Vt enim flamma medicis cucurbitulis aut angusto conclau coërcita marcescit, ita et quum animanti fauces praeccluduntur, obturanturque omnia cutis spiracula, quàm mox caloris sequitur extinctio. Huius quidem [P148] causa triplex, quòd denegata sit refrigeratio, quòd idoneum deficiat pabulum, quòd offusus aër nullus sit, in quem fumosa ignis calorísve excrementa pellantur aut erumpant. His enim tribus de causis consequitur caloris interitus et extinctio, quandoquidem is trium contrariarum adminiculis ex necessitate indiget. In balneis, in caldariis et in aestu vehementi, qui nos regit et moderatur calor, idcirco languet et extabescit, quòd frigoris occursatione nequaquam reficiatur. Qui enim nos circumsepit aestus si immoderatus est, haud secus calorem nostrum atque lucernae flammam foras euocat prorsúsque dispergit, nihil aut certè perquam exiguum illius reliqui faciens: hinc virium infirmitate tentamur et affligimur, intabescimus, et ad extremum vitam cum morte commutamus. Contrà frigus moderatum et aequabile perinde vt flammam, ita et natium calorem continet et à dissipatione tutatur: tametsi immensum et immodicum frigus si diu multúmque adest, flammam et calorem ad materiam intrò reprimens, aequè vt aduersus calor vitam eripit. Neque nos ambiens calor ex eo duntaxat quòd interiorum nostrum dissipet, offensionem affert, verùm hinc etiam quòd neuti-quam refrigeret, imò verò cor et interiora viscera magis ac magis inflammet, vnde propria illorum substantia consumitur et in perniciem agitur. Tale quid-dam manifestiùs infert calidus feruidúsque aër diutius inspiratus. Eadem ex causa in pauco eodémque aëre continenter et assiduè versati suffocamur, aequè vt in aqua modica pisces. Qui enim exiguus est aër reddito spiritu facile concalescit, vt deinde nequeat refrigerationis auxilium praestare. Quin etiam motio vehementior, aestus aut balnearum ritu, innatum calorem diffundit, disperditque, moderata hunc conseruat et excitat, quies autem sopit et ignauum inertémque reddit: quemadmodum mediocris ventilatio

Chapter 16. Our heat needs cooling, fuel, and purification all the time, or it is quenched and declines.

THE REMARKABLE and celebrated nature of things has brought it about that everything that is nourished and grows contains within itself the power of heat, without which it can neither be nourished nor grow; this includes animals, whose kind of life was to be more perfect than that of plants, and [so] they have received a more abundant heat, clearly so that its tempering would preserve their whole state of life. Again, all animals that possess blood overflow with heat more abundantly than those that lack blood. Although this heat of ours is ethereal, it always needs the impact of cold air, and is soon totally quenched if that fails. The flame confined in medical cupping-glasses or a small chamber dies away; in the same way the heat is very speedily quenched when an animal's throat is blocked and all the vents of the skin are shut off.³⁶ There are three [P148] causes for this: cooling has been refused, or suitable fuel fails, or there is no supply of air into which the smoky wastes of fire or heat can be ejected. From these three causes quenching of the heat ensues, since of necessity the heat requires the assistance of three opposite things [cooling, fuel and air]. In baths and hot chambers, and during very hot weather, the heat controlling us weakens and declines through not being restored by the onset of cold. If the seasonal heat surrounding us is immoderate, it summons forth our heat and the flame of a lamp in the same way, dispersing them entirely, leaving none or anyway very little of the heat behind; so we are afflicted by weakness of our powers, we waste away, and ultimately we exchange life for death.

On the other hand, just as moderate and uniform coldness sustains a flame, it sustains innate heat too, protecting it from dispersal. All the same, if vast excessive cold persists a great deal, pushing flame and heat back into material, it snatches away life, like its opposite, heat. Ambient heat does not produce injury just by dispersing our internal heat, but also by entirely failing to cool; indeed, it inflames the heart and internal organs more and more, till their particular substance is consumed and brought to destruction. Inhaling intensely hot air for some time produces a similar result more obviously. It is for the same reason that we are suffocated by spending time continuously in a small unchanging quantity of air, as are fish in limited water. Scanty air readily heats up through spirit being returned to it, so that afterwards it cannot provide the needed cooling. Further, too violent motion is like hot weather and baths, and dissipates the innate heat, while moderate motion preserves and stimulates it; repose puts it to sleep and makes it sluggish, in the way that moderate fanning

flamnam auget, nimia dissoluit. Caeterum neque in balneis, neque in solis ardoribus calori deest alimentum, sed hac vnica causa extinguitur is et occidit, quod frigoris appulsu non recreatur. Vt autem respirationis maior iniecta corpori necessitas est quam transpirationis, ita hausti frigoris commoditas maior est, quam nos vndique cingentis. Ex quo fit vt qui ex lebe calidum aërem spiritu trahunt, etiam si reliquum corpus frigido aëre circumfunditur, celerius extinguantur et intereant, quam qui in hypocausto constituti ore atque naribus frigidum aërem ducunt. Porro autem ob alimenti aegestatem [corrected to "egestatem" in Errata at end of the volume] is vitam amittit, cui os et nares vel fauces praeccluduntur: non modò enim refrigerationis defectio, sed eius maximè pabuli inopia premit, quod caloris substantiam conseruat. Id quidem planius [*sic*] declarat corpus quodcunque in frigidam demergitur: mox enim id suffocatur et perit, nisi aëre et respiratione iuuetur, non quod a refrigeratione, sed quod ab idoneo caloris et spiritus alimento destitutum sit. Quum quis autem plurimo attracto aëre eoque frigido hunc vniuersum sic pulmonibus comprehendet, vt nihil deinde illius expiret, eum profectò tandem extinguì et è vita discedere necesse est: non alimenti penuria, vt quod copiosum insit et abundans: non refrigeratione prohibita, quod frigidus haustus sit aër, qui pulmones et cor potuit vel immodicè refrigerare. Quanam igitur tum relinquitur interitus causa? Ea nimirum quod fumosa insiti caloris spiritusque superuacanea non reddantur: atque vt flamma à crasso multoque fumo, ita cor ab illis immoderatè congestis opprimitur atque strangulatur. Huius id esto indicium, quod qui sic grauiter vehementerque affliguntur, expiratione alleuantur recreanturque, èstque ea tum illis vnica medicina, quae suffocantes halitus atque fumos eiicit. Has tres causas ad insiti caloris, et ad omnium terrenorum animantium custodiam condonatas, ambiens nos aër in se vnus continet, si tum qualitate tum substantia mediocritatem quandam acceperit. Aquatilia autem non aër, sed aquae humor tuetur, vt qui refrigerationis vsum et commoditatem illis suppeditat, nisi quum immodicè exardescens robur eorum adimit, omnibusque orbat viribus. Ab humore nonnihil etiam vaporis et halitus pro caloris spiritusque pabulo trahunt, in quem commodè fumosa caloris superuacanea depellunt. Id inter animantes discriminis peperit innati caloris varietas: quum enim in terrenis animantibus multo sanguine eoque puriore praeditis, copiosus et vberimus sit vitae calor, celeri quidem et prompta refrigeratione atque nutritione indiget: quae sanè aër facile confert, quia leuitate subtili celeriter in omne corpus [P149] penetrat, móxque partibus singulis praesens est et obuius. At verò pisces quibus multo minus tum caloris, tum sanguinis inest, cum non aequè subito tantum refrigerij desiderent, solius aquae contagione appulsuque satis commodè sustinentur.

increases a flame, but too much blows it out. However, there is no lack of nutriment for heat in the baths or in the sun's heats; the sole reason the fire goes out [there] is that it is not restored by the impact of cold. A greater need for respiration is implanted in the body than for perspiration; hence the value of cold drink is more than that of cold all around us. The result is that people who draw hot air in from a cauldron by breathing, even if the rest of their body is surrounded by cold air, die quicker than those who while in a hot room inhale cold air by mouth and nose. Besides, anyone whose mouth and nostrils or throat are blocked loses his life through dearth of fuel ["*alimentum*"], afflicted by lack not just of cooling but of the fuel that maintains the substance of heat. This is revealed more clearly if any body is plunged into cold water; it is quickly suffocated and dies unless aided by air and breathing, through deprivation not of cooling, but of suitable fuel for heat and spirit. And when anyone inhales a lot of cold air, and holds it all in his lungs so that he breathes out none of it afterwards, he must end up quenched and depart this life: not through lack of fuel, since there is plenty in him; not through arrest of cooling, because cold air has been ingested that could chill the lungs and heart, even too much. So what cause of death is left? Presumably that the smoky redundant matters of the resident heat and spirit are not being expelled again; a flame is suppressed and choked by much thick smoke, and so is the heart by these excess accumulations. Let this be the evidence: those who are seriously distressed in this fashion are relieved and restored by exhaling, which is at the time their one medicine that expels the suffocating vapors and fumes. These are the three agencies granted to watch over the resident heat and all animals on earth, and the air surrounding us is alone in containing them, so long as it has acquired some moderateness in quality as in substance. Aquatic creatures are maintained not by air but by the moisture of water, which is what supplied them with the valuable utility of cooling, unless it heats up too much and removes their strength, depriving them of all their powers. From the moisture they extract some vapor and breath too, as fuel for the heat and spirit, and into it they conveniently unload the smoky superfluities of heat. The different innate heat has brought about this distinction between animals: since the vital heat is plentiful and very abundant in terrestrial animals, with their large supply of blood (and purer blood too), it requires fast ready cooling and fuel supply; this is certainly easily got from air, because it is so subtle and rarefied that it [P149] makes its way rapidly into all of the body, and soon makes its presence obvious in individual parts. But fish, with much less of both heat and blood, and not an equally urgent or great need of cooling, are sufficiently maintained just by the contact and impact of the water.

Pulsus et respirationis usus: utque inter se distent. Cap. XVII.

IN EA corporis parte quae immensa aestus ac caloris vi quodammodo efferuescit, natura gubernatrix, et quasi magistra animantium, vim posuit cientem agitantemque motionibus perpetuis, cuius tamen impetum reliquae etiam corporis partes minus calidae percipiunt, ut in quas fundi ac dimanare solet. Ea est vis et facultas quae cor suis motibus exagitans aërem idoneum in idipsum rapit, et ab eodem excrementa quae plena sunt fuliginis foras expellit. Eadem ex corde per arteriarum corpora peruadens illas distendit atque demittit, ut partes in quas distributae sunt, frigore reficiantur, et earum superuacanea propulsentur. Quandiu ergo harum omnium partium ingeneratus calor moderatus erit isque exiguus, hunc quidem satis conseruare videbitur arteriarum pulsus, quem eo nomine incredibiliter natura machinata est. Vis enim quae à corde initium ducens per arteriarum tunicas demittitur et influit, illas quidem eodem modo atque eodem tempore atque cor attollit et summittit. Cum attolluntur ac dilatantur, sese suaque spiracula aperiunt, et vndique ad se tum ambientem nos aërem, tum proximi sanguinis tenuem portionem trahunt. In his enim communes transitus existunt per tunicarum spiramenta et oscula, alij in cutem, alij in intestina et viscera, alij in venas, hoc indicio quod vulnerata magna arteria vniuersus animantis sanguis profunditur. Cum verò summittuntur atque contrahuntur, fumida et halitiosa superuacua, quae ex humorum et spirituum vstione proueniunt, tum in cutem, tum in alias partes expellunt. Sic igitur perflabile corpus est, et arteriae suo pulsu tum ex omni parte trahunt, ut natium calorem conseruent, tum in omnem partem transfundunt, ut eum ipsum ab omni eluue liberent et expurgent. Caeterum cor quod calore ingenti tanquam flamma exardescit, non satis commodè potest arteriarum pulsatione conseruari, sed maiore quodam adminiculo quasi flabello indigebat: cuiusmodi in his animantibus quae multo sanguine et calore vigent sunt pulmones, in piscibus verò branchiae. Dum enim cor ardoris incendio flagrat, nec satis valet pulsatione agitationeque sua refrigerationem consequi et sibi asciscere, tum temporis pulmones ipsamque sentiendi vim premit et irritat, efficitque necessitate quadam, ut mouendi facultas diaphragma et thoracem hincque annexos pulmones,

Chapter 17. The value of pulse and respiration, and the difference between them.

IN THE part of the body that boils up in some way with the immeasurable power of heat, nature the controller, and (so to speak) the sovereign ["magistra"] of animals has placed a power that stimulates with constant movements; but its effort is felt by the rest of the bodily parts too, which are not so hot, as it usually is emitted and percolates into them. This is the power and faculty that shakes the heart by its motions, snatches suitable air into it, and drives out wastes from it that are full of soot. Penetrating from the heart through the bodies of the arteries, it distends them ["distendit atque demittit"], so that the parts to which they are distributed are restored by cold, and their wastes are driven forth. So, for as long as the innate ["ingeneratus"] heat of all these parts is moderate and slight, it will be seen to be adequately preserved by the arterial pulse, which, unbelievably, nature has devised for that purpose. The power that takes its origin from the heart and is distributed ["demittitur et influit"] along the coats of the arteries dilates and contracts ["attollit et summittit"] them in the same way and at the same time as it does the heart. When dilated ["attolluntur ac dilatantur"], they open up themselves and their vents, and draw into themselves from all sides both the air surrounding us and a rarefied portion of the adjacent blood. Common paths are present in them through the vents and apertures of the coats, some leading into the skin, some into the intestines and viscera, some into the veins; the evidence is that when the aorta is wounded all the blood in the animal runs out. But when they are contracted ["summittuntur atque contrahunt"], they expel smoky and vaporous redundant matter produced by the combustion of humors and spirits, into both the skin and other parts. So it [the matter] is a body capable of being blown along ["perflabile"] in this way, and the arteries by their pulsation draw it from every part, to conserve the innate heat, and transfer it into every part, to clear out all the refuse from the heat.

But the heart blazes with great heat, like a flame, and so cannot be maintained sufficiently appropriately by arterial pulsation, but was in need of some larger implement, such as a fan; of this sort are lungs in the animals that thrive with plenty of blood and heat, and gills in fishes. When the heart is blazing with fiery heat and lacks the strength to achieve cooling by its pulsatile activity, is when it presses on and provokes the lungs and the very power of sensing, and brings it about through a certain necessity that the faculty of movement repeatedly lifts up and presses down the diaphragm and chest, and the lungs attached

crebrò tollat deprimátque. Dum autem pulmones attolluntur, in eos tanquam in follem spiritus adducitur, redditur verò, cùm deprimuntur et concidunt in sese. Hoc igitur modo qui inspiratione haustus est frigidus aër, celerrimè ad intima quaeque penetrat, iisque refrigerationis commoda subministrat. Vt verò reliquarum partium calorem arteriarum pulsus, sic cordis ardorem inspiratio temperat, eundem purgat exspiratio, fumosa excrementa propellens. Quocircà inspirationi rectè comparatur diastole, expirationi systole. Ergo vnus eiusdémque vsus causa respiratio et pulsus dati sunt animantibus: hoc solum distant et dissident, quòd illa ab animali facultate, hic autem à vitali manat: hic continuus est neque interruptus, extra omnem arbitrij nostri potestatem, illa plerunque cessat libera quidem et in nostra potestate. Quod enim respirationem excitare possumus cùm volumus et eandem crebriorem aut rariorem, tardio rem aut velociorem reddere, contràque sedare et cohibere cùm volumus, apertè com-mo-strat eam esse motum voluntarium, nostróque subiici arbitrio. Non sic autem motum cordis et arteriarum, quem nec excitare, nec sedare, sed ne mutare quidem aliter possumus etsi volumus. Respirationem prorsus continere et cohibere arduum in primis est et difficile, quòd si exiguo quodam tempore aut certa mensura, non tamen perpetuò possumus. Quocirca non illa similiter atque ambulatio aut locutio prorsus est libera et in nostra potestate sita, sed quadam affectus necessitate ducitur et incitatur. Erunt igitur in motibus voluntariis alij prorsus et absolutè liberi, quos quoties et quantum volumus impellimus, [P150] nulla ad id nos vrgente necessitate: alij liberi quidem, sed à quibusdam corporis affectibus incitati atque laccessiti: quod genus sunt, respiratio, vrinae et excrementorum alui retentio. Fiunt hae quidem ab animali facultate, idque musculorum beneficio, vnde et arbitrio nostro fieri dicuntur: caeterùm quoniam multa plerunque actiones illas perturbant, magnàque necessitate laccessunt, non quantum et quomodocunque volumus, illas complere possumus. Quare quanquam liberae sunt et voluntariae, non tamen absolutè, sed corporis affectibus subditae.

Qua ratione fiant respiratio atque pulsus. Cap. XVIII.

PULSATIO tum cordis, tum reliquarum partium calorem fouet: sed et cordis calorem respiratio continet, ad quam pulmones planè accommodati sunt et à natura contributi. Huius quidem efficiens causa est, libera illa et voluntaria facultas, cui instrumenta praesto sunt, diaphragma et thorax variis musculis agitatus, tum iis qui inter costas positi sunt, tum iis

to them. While the lungs are being dilated, spirit is drawn into them, just as into bellows, and is returned when they are squeezed and collapse into themselves. Thus the inhaled cold air makes its way very swiftly into all recesses, and supplies them with the benefits of cooling. And in the way that the arterial pulse moderates the heat of the rest of the parts, inhalation moderates the conflagration of the heart, and exhalation cleanses it, expelling the smoky wastes. So it is right to compare diastole to inhalation, and systole to exhalation. Therefore, breathing and pulsation are given to animals for one and the same need; they differ only in that respiration is derived from the animal faculty and pulsation from the vital one. Pulsation goes on all the time, beyond any control by our will; respiration often stops, being free and within our control. We can stimulate respiration when we wish and make it more or less frequent, slower or faster, and on the other hand soothe and restrain it when we wish. This manifestly shows that it is a voluntary movement, and subject to our will. The movement of heart and arteries is different: we cannot stimulate it, soothe it, or change it in any other way even if we wish to. To hold one's breath completely is an outstandingly difficult thing, and beyond us in the long run, even if we can do it for some short or fixed period. Consequently it is not an entirely free thing, within our power, like walking or speech, but is brought on and evoked by a compulsive influence ["affectus necessitate"]. So among voluntary movements there will be some entirely and completely free, which we put in motion as often and as much as we want, without the [P150] urge of any compulsion. Others are free, but provoked by certain bodily influences; such are respiration, and the retaining of urine and of bowel refuse. These are the work of the animal faculty, and thanks to the muscles, and hence are said to occur at our decision; but as many things (mostly actions) disturb them and challenge them with great compulsiveness, we cannot fulfill them as much as we want or in whatever way we choose. So although they are free and voluntary, they are not completely so, but subject to bodily influences.

Chapter 18. The basis on which respiration and pulsation
happen.

PULSATION FOSTERS the heat both of the heart and of the other parts; but also, the heat of the heart is sustained by respiration, for which the lungs are clearly adapted and provided by nature. Its efficient cause is that free voluntary faculty, which has instruments at the ready: the diaphragm and chest kept in motion by various muscles, both those lying between the ribs, and those

qui extrinsecus sunt adhibiti, interdum et iis qui sunt in abdomine. Est et aspera arteria respirationis via, et pulmo receptaculum materiae, quam inducimus. Materia verò aër, qui tum per os, tum per nares attrahitur. Itaque mouens illa et voluntaria facultas, dum ardoris necessitate tanquam stimulo impellitur, musculorum ope thoracem, simulque quadam consequutione pulmones distendit, qui leues atque rari facilè sequuntur quocunque ducas. Dilatati autem necessariò implentur leui quodam profluentéque corpore per asperam arteriam irruente, cuiusmodi maximè est ambiens nos aër. Compresso autem thorace vnà pulmones demittuntur, et qui in illis superuacui sunt spiritus per arteriam excluditur. Si modica ad respirandum astringimur necessitate, huic obeundae vnum certè diaphragma suffecerit, quod deorsum impulsum pulmones secum adducens leuiter attollit, reductum autem eosdem comprimit colliditque. Sin autem grauior vrget necessitas, praeter diaphragma thorax modicè attolletur, eorum musculorum ope, qui inter costas positi interiorem sedem habent: contrahetur autem sua ipsius grauitate concidens in mediocrem naturalémque situm. Cùm autem maxima fit inspiratio, illis omnibus actionem suam conferunt ij muscoli, qui thoraci extrinsecus incumbunt, et quos maximè ab humeris ad thoracis superiora diriuari diximus, omniùmque vno impetu atque conatu thorax plurimum distenditur. Plurimum autem contrahitur in vehemēti expiratione, qualis est appellata exufflatio, ita quidem thoracem infra naturalem situm comprimētibz iis musculis, qui inter costas positi exteriorem sedem habent, suffragantibus etiam aliis qui extrinsecus thoracis inferiora tegunt. Alterna igitur horum musculorum actione respiratio completur partibus duabus absoluta, inspiratione et expiratione. Inspiratione ambiens aër per os et nares in asperam arteriam insiliens, non modò eius ramos per pulmonis substantiam diffusos, sed et omnem ferè eius molem implet, adeò vt vniuersam thoracis capacitatem inflatus spiritúque turgens pulmo occupet. Qui haustus aër fuerat, primam in pulmone elaborationem sumit, illícque concoquitur et praeparatur vi carnis quae planè tenuis est, mollis et aërea, vt proinde huiusce operis, quemadmodum et caro iocineris, sanguinis conficiendi causa maximè constructa esse videatur. Non enim externus aër, rudis, frigidus, et impurus, et derepente irruens fieri potest interioris spiritus conueniens pabulum, sed hunc quemadmodum et alimenta necesse est paulatim mutari et familiarem innato spiritui qualitatem, longiuscula mora recipere. Posthaec autem elaboratus diligenter spiritus, in sinistrum cordis ventriculum arripitur, ex quo accedente etiam sanguinis vapore, qui ex dextro ventriculo permanauit, vi cordis insita, eiusque

brought to bear from outside, and sometimes those in the abdomen too. The trachea also is a path for respiration, and the lung a store for material we take in. The material is air, which is drawn in through both mouth and nostrils. And so that voluntary faculty of movement, goaded by the compulsion of heat, dilates the chest with the help of muscles, and with it as a result the lungs; they, being light and loose-knit, follow readily wherever you lead. When dilated, they necessarily get filled with a light and fluid body rushing in by the trachea, and the air surrounding us is particularly of this sort. On the other hand, when the thorax is squeezed the lungs give way [*“demittuntur”*] at the time, and the superfluous spirit in them is expelled through the trachea. If we are obliged to breathe by moderate compulsion, the diaphragm on its own would surely be enough for this, because when it is pushed down it carries the lungs with it and dilates them gently, but when restored again, squeezes and collapses them. If however there is a more pressing compulsion, in addition to the diaphragm the thorax is moderately dilated, with the help of the intercostal muscles that lie internally; it will be contracted by settling into a medium and natural position under its own weight. But when a maximal inhalation occurs, there is added to all these the action of the muscles applied to the outside of the chest, which we said had their origin particularly from the shoulders at the upper part of the chest; the combined [*“vno”*] effort of all these greatly dilates the chest. It is greatly contracted in strong exhalation, such as what we call blowing out,³⁷ when the intercostal muscles occupying an external position squeeze the chest below its natural level, aided also by others that cover the outside of the lower chest. By an alternating action of these muscles, respiration is brought to completion in two parts: inhalation and exhalation. In inhalation the ambient air leaps into the trachea through the nostrils, and fills up not only the tracheal branches distributed through the pulmonary substance, but also nearly all of its bulk, so much so that the lung, inflated and swollen with spirit, occupies the whole of the thoracic cavity.³⁸ The air that had been drawn in receives its first processing in the lung, and there is concocted and prepared by the power of flesh that is clearly rarefied, soft, and airy; accordingly it appears particularly built to do this, as hepatic flesh is to make blood. For the outside air, unrefined, cold and, impure, and abruptly rushing in, cannot become a suitable fuel for the spirit inside; it has to be gradually changed, as foods are, and take on with some delay the quality congenial to the innate spirit. Subsequently the spirit,³⁹ carefully perfected, is carried off into the left ventricle of the heart. Out of it vital spirit is generated, by the further addition of the vapor of blood percolating in from the right ventricle, and through the inherent power of the heart and its

innato spiritu et ingenti caloris incendio, haud secus atque in fornace spiritus procreatur vitalis, qui demum in omne corpus per arterias effusus, salutarem impertit toti calorem. Qui ex hac concoctione fiunt torridi vapores, foras reiciuntur tum cordis et arteriarum pulsatione, tum pulmonis expiratione. Quum igitur thorax attollitur, asperae pulmonum arteriae aëre per inspirationem implentur, simul autem laeues [arteriae] implentur fumoso excremento, quod ex sinistro cordis sinu depellitur, ne id prauitate suffocet: venae arteriosae tenui sanguine [P151] distenduntur, qui ex dextro cordis sinu ad pulmones nutriendos eiicitur. Quum autem depresso thorace pulmones in se concidunt, vasis hisce omnibus quodammodo coarctatis, per asperas quidem arterias expiratio fit excrementi fumosi, per laeues autem quas venosas diximus appellari, praeparatus et quasi concoctus in pulmone aër, in sinistrum cordis sinum coniicitur. Qui in venis est tenuis sanguis, pulmonis coarctatione in dextrum cordis sinum haudquaquam remeat, sed in carnem pro alimento truditur, ab eius singulis partibus familiaritate quadam raptus, veruntamen hae venae, vt quae ex duplici constant tunica, sanè quàm parum comprimi possunt expiratione, vt neque dilatari inspiratione, sed eos motus praesertim subeunt arteriae, quae propria sunt spiritus instrumenta. Eo autem ordine collocata sunt tria haec vasa, vt aspera arteria vbique media et inter laeuem arteriam atque venam interposita cernatur: non haec quidem extremis continuata sunt, neque qui in aspera arteria est aër, mox in laeuem transfertur: sed cùm extremae omnium fibrae in omnem pulmonis substantiam dispersae sint, quicquid in illis est conceptum, id omne in pulmonis substantiam illabitur. Per hanc (quia mollis est et summè rara) tum aër, tum fumosum excrementum facilè commeat, et expiratione in idonea vasa relabitur: sanguis verò cùm ex venis in carnem effluerit, in illius substantiam conuertitur, nec potest (nisi propter vlcus quale est in tabe) in asperas arterias retrò commeare: quanquam quae ex pulmonis nutritione quotidie progignuntur excrementa, per eas vnà cum sputis redduntur. Hanc cuiusque materiae distributionem efficit pulmonis respiratio, cui et maximam vim addit cordis motus et pulsatio. Cor enim diastole ex pulmone per laeues arterias praeparatum aërem in sinistrum sinum rapit, et ex vena caua sanguinem allicit in dextrum suum sinum, idque patefactis horum vasorum valuis. Systole ex dextro sinu per venam arteriosam sanguinem in pulmones effundit, ex sinistro verò confectum iam vitalem spiritum in maiorem arteriam (quae aorta

innate spirit and huge blaze of heat, just as in a furnace. Pouring out through the arteries into all of the body, it ends by conveying wholesome heat to the whole. The parched vapors that result from this concocting are ejected to the outside by cardiac and arterial pulsation and by pulmonary exhalation. Then when the chest is dilated, the bronchi [*“asperae pulmonum arteriae”*] are filled with air by inhalation, and at the same time the smooth arteries⁴⁰ are filled with smoky refuse expelled from the left chamber of the heart, to prevent it from suffocating through faultiness; the arterial veins [pulmonary arteries] are [P151] distended with rarefied blood, which is expelled from the right chamber of the heart to nourish the lungs. But when the lungs collapse into themselves during the squeezing of the chest, all these vessels are, so to speak, constricted, and there is an exhalation of smoky refuse through the bronchi; but air prepared and (as it were) concocted in the lung is delivered into the left chamber of the heart, through the smooth arteries that we said were called venous. The rarefied blood in the veins certainly does not return into the right chamber of the heart on contraction of the lung, but is driven into the flesh as nutriment, seized by its individual parts through a certain close relationship. The veins [branches of pulmonary arteries], however, possessing a double coat, are clearly capable of very little compression during exhalation, nor of dilatation during inhalation; it is especially the arteries, the particular instruments of spirit, that undergo these movements. These three vessels lie in such an order that the bronchus is always found in the middle, between the smooth artery and the vein. These are not continuous with the tips [of each other, presumably], nor is the air in the trachea rapidly transferred into the smooth artery; but when the ultimate threads of them all disperse into the whole lung substance, anything they contain slips into the lung substance. This, being soft and extremely loose-knit, is easily traversed by both air and smoky refuse, which on exhalation ebbs into the appropriate vessels; the blood, when it has streamed out of the veins into the flesh, is transformed into its substance, and cannot make its way back into the bronchi, unless on account of an ulcer (as in wasting); however, the refuse generated daily from the nutriment of the lung is expelled again through them along with sputum. It is the lung's breathing that brings about this distribution of each material, breathing to which the heart's pulsatile motion contributes very great power. Cardiac diastole seizes prepared air from the lung through the smooth arteries into the left chamber, and lures blood from the vena cava into its right chamber, when the valves of these vessels have opened. Systole pours blood from the right chamber through the arterial vein into the lungs, and from the left chamber what is now perfected vital spirit into the greater artery (called

dicitur) simulque in minores emittit, quo tempore necesse est omnes dilatari. Quanquam igitur earum motus cordis pulsationi similitudine quadam magnitudinis, celeritatis et frequentiae respondet, ut ex earum contactu cordis motum coniectura assequi liceat: hae tamen dilatantur in systole cordis, committuntur autem in diastole. Dilatantur enim dum compressum cor in eas spiritum immittit. At non solius influentis spiritus et sanguinis in vapores extenuati copia implentur: non enim fieri tum posset ut omnes vno eodémque momento pulsarent, quòd nequeat puncto temporis spiritus per arterias in corporis extrema peruadere. Ergo quum simul omnes pulsare deprehenduntur, quaecunque hosce diastoles et systoles motus efficit causa, eadem sanè et quae cor mouet. Ea est in arteriarum corpore posita, sed quae tamen suam originem aut certè conseruationem cordi acceptam referat. Caeterùm quae in corde vis inest pulsus efficiens, ea vitalis nequaquam est, quae tum spiritum, tum vitalem in eo calorem gignit: haec enim in solo corde collocata est et consedit, illa verò arteriis et cordi coniuncta atque communis est. Haec vitalis, vires suas in ossa, cartilagine, carnem, in omnes denique partes diffundit, quibus vitam et salutarem calorem impertit, nullaque pars manet ab illius aspiratione et fauore destituta; contrà, quum à corde et arteriis discesseris, quae pulsu motionéque agitetur, pars omnino nulla in conspectum se dabit, nisi cerebrum fortassis in illorum numero reponendum esse videatur. Ex quibus profectò perspicuum fit, vim illam pulsanter plurimùm à vitali discrepare, esseque tanquam ancillulam et ministram tum spiritus eius et caloris distribuendi, tum ut innato calori modus quidam adhibeatur, certaque is ratione gubernetur. Simili modo atque ratione à vitali eae diuersae sunt facultates, quae excandescunt et alias animi affectiones concitant: de quarum operibus quum iam plenè cumulatèque verba fecerim, nihil superesse arbitror, quod huic tractationi videatur attexendum.

LIBRI SEXTI DE FUNCTIONIBUS ET HUMORIBUS,
FINIS.

the aorta) and also into the lesser ones, at a time when they must all be dilated. Then it is true that their motion corresponds to cardiac pulsation in mimicking in a way its size, speed and frequency, so that by touching them it is possible to deduce the movement of the heart; however, they are dilated during cardiac systole, and contracted in diastole. They are dilated during the introduction of spirit into them by the contracted heart. But they are not filled by the abundance just of inflowing spirit and of blood thinned out into vapors; it would be impossible for them all to pulsate at one and the same moment, since spirit cannot penetrate through the arteries into the limits of the body in a twinkling. Therefore, when they are found all to pulsate together, whatever cause it is that brings about these movements of diastole and systole is clearly the same one that moves the heart.⁴¹ It is situated in the body of the arteries, yet owes its origin or certainly its preservation to the heart. But the power in the heart that produces pulses is not the vital one at all, which generates both spirit and vital heat in it; that one is situated and resides in the heart alone, but the pulse-producing one is linked to the arteries and the heart, and shared by them. The vital one distributes its powers into bones, cartilages, flesh, indeed into all parts, and bestows life and wholesome heat upon them; no part stays deprived of its exhalation and goodwill. On the other hand, when you have departed from the heart and arteries, no part at all with a forceful pulse and movement will present itself to view, unless perhaps the brain seems fit to include in their number. From this it becomes clear without question that the pulsating power differs very much from the vital one, and serves as a little serving girl, both for the distributing of its spirit and heat, and to apply to the innate heat some limit, with control on a definite regime. The faculties that arouse flaring rage and other affections of the mind ["animus"] differ from that vital faculty on a similar basis; since I have now said amply enough about their workings, I think there is nothing left over that seems to need adding to this account.



DE HOMINIS PROCREATIONE ATQUE DE SEMINE. LIBER VII.

Praefatio.

[P152] CORPORIS TOTIUS constitutionem, partis cuiusque situm, vsum, figuram, ex elementis compositionem iam antè exposuimus, et quibus facultatibus adornatus homo singulas functiones edat. At quoniam nec elementa, nec quae ab his emergunt temperamenta, facultatum causas statuimus, nunc ordinis ratio locúsque postulat, vt inuestigemus quatenus sint earum causae. Quapropter toto animo et studio omni perquirendum, sitne praeter primam illam ex elementis compositionem communémque rerum omnium procreationem, singularis quaedam in animalibus vis, quae facultatum causas in se contineat. Hoc enim pacto futurum est, vt hac serie saepius repetita atque paulò altius relata, ab iis quae sensibus subiecta sunt, in occultas et abditiores causas demum penetremus. Itaque dum hominis ortum atque procreationem in medium proponemus, dúmque explicabimus quas vires obtineat procreandi facultas, quomodo quóque ordine partes conformentur singulae, vtque foetus in vtero gubernetur: tum simul omnium quae libris superioribus tradita sunt à nobis summa causa et ratio perspicuè elucebit. Neque profectò fieri potuit, vt prius hominis procreatio intelligeretur, quàm is esset numeris omnibus cognitus et exploratus: quisquis diuersum doctrinae ordinem instituet, eum necesse est in obscura multa et inexplicabilia inuolui. Primùm enim (inquit Aristoteles) nouisse oportet, an sit vnumquodque de quo futura est disputatio: deinde quid sit, tertio loco vnde et à quo id sit. In hunc itaque locum hominis procreationem tradere distulimus, quanuis fortè nonnulli pulchrum putarent, ab hac facto artis exordio, ad alia deinde progredi.



BOOK 7

ON HUMAN PROCREATION AND ON THE SEMEN

Preface.

[P152] WE HAVE already explained above the character of the whole body, and for each part its location, utility, shape, and composition from the elements, and with what faculties man is provided to discharge individual functions. But we have neither the elements nor the temperaments that arise from them as the causes of the faculties, and so now the pattern of the sequence and the place in it require that we investigate what their causes are. For this we must inquire with our whole mind ["animus"] and all our zeal, whether there is some special power in animals that encloses within itself the causes of the faculties, in addition to that original assembly out of the elements and general procreation of all things. On this plan it will come about that we shall ultimately penetrate from what is before the senses into the hidden and more remote causes, by repeating this sequence quite often and carrying it a little further. And so we shall make our topic the origin and procreation of man, and explain what powers the faculty of procreation possesses, how and in what order the separate parts are shaped, and how the fetus is controlled in the womb; meanwhile the ultimate cause and basis of all that we related in the earlier books will clearly emerge. It has certainly been impossible for man's procreation to be understood until he is known and investigated in all features; anyone who sets out upon a different order of teaching inevitably gets entangled in many insoluble obscurities. First of all, says Aristotle, it is required to know whether the matter for debate is a single thing ["unumquodque"; properly means "each single one"]; then what it is; thirdly, whence and from what it is. And so we postponed the account of human procreation until now, though perhaps a number of people would think it attractive to make that the start of the exercise, and then go on to the rest.

*Sexuum distinctio unde sit, et quid de semine sit ab Aristotele
proditum. Cap. I.*

QUAE RERUM omnium pulcherrimae sunt ac summè diuinae, id vnum prae caeteris diuinitatis suae specimen obtinent, vt sempiternae quidem sint et immutabiles, nulli affectionum impetui subiectae. Haec autem cùm summa quaedam sit perfectio, et praestantissimum supremùmque bonum sit bene viuere, vitæque frui laetissima, iure ac merito quae mortali conditione generata sunt, eo aspirant, et esse viuerèque natura desiderant. Quanquam autem fieri nequit, vt id perfectè et omnino consequantur, hoc tamen nacta sunt, vt quodammodo sempiterna sint: non numero quidem, verùm specie, quae semper est et aeterna. Quapropter immutabili aeternitate continuantur viuientium ortus et procreationes, vt quod singulari substantia seruari nequit, specie saltem persistat. Etenim vsuuenit vt vnumquodque indiuiduum cùm mortale et dissolubile se sentiat, aliud sibi simile optet in suum locum reponere, in quod et languidam et inclinantem suam vitam quodammodo conferat, et per quod procreatione quasi repuerascens atque renouatum, quodammodo perpetuum fiat et aeternum. Haec est illa procreandi libido: quae vt species in perpetuum salua conseruaretur, cunctis est viuentibus à natura tributa. Hanc enim et frutices acceperunt, quas procreare manifestum est, atque etiam nutriri et increscere. Quum autem hae alimento iugiter inhaerescant altissimis defixae radicibus, nec ad mouendum sint aptae, ex seipsis progignunt nullo alterius congressu. Huiusce rei causa natura promiscuum sexum maris ac foeminae stirpibus attribuit, vt confusas ac perpetuò mixtas haberent maris ac foeminae vires. At [P153] verò animantes quia non solum in procreationem et nutritionem incumbunt, sed praeterea sensus ac cognitionis participes ad alias quasdam praestantiores functiones comparatae, maris ac foeminae sexu distinctae sunt. Sic enim melius ad alia quaedam praestantiora cognitionis munera se conferunt, nec penitus alimento affixae omni impetu in procreationem ruunt. Si quando igitur generare debent, commisceantur coëantque necesse est, et (vt inquit Aristoteles)¹ ex ambobus quasi vnum fiat animal. Fieri itaque non potest, vt vel mas per se, vel sola foemina ex seipsa animal perfectè generet, quanquam plerunque rudem quandam et inchoatam molem producit, quod de mola et gallinarum ouis, quae nostri subuentanea dixerunt, compertum habemus. Infoecunda

Chapter 1. The origin of the difference between the sexes, and what Aristotle handed down about the semen.

THE MOST beautiful and supremely divine of things possess this single evidence of their divinity over and above the rest, that they are eternal and immutable, open to no influence from what they encounter ["affectionum"]. Since this is a peak of perfection, and it is the most excellent and supreme good to live well and enjoy a very happy life, rightly and properly the things that are generated in a mortal state hanker after that, and by nature desire to exist and live. Though it is impossible for them to achieve this perfectly and completely, they have reached the point of being eternal in a fashion, not indeed in detail ["numero"], but in form, the form being forever and eternal. Therefore the origins and procreations of living things are continuous in immutable eternity, as what cannot be preserved in its particular substance does at least persist in form ["specie"]. For experience shows that each single individual, sensing that he is mortal and subject to disintegration, wants to put something like himself in his place, to which he devotes in a way his enfeebled and declining life, and through which he becomes in a way permanent and timeless, so to speak resuming his youth by procreation. This is the traditional ["illa"] desire to procreate; nature has given it to all living things, to preserve the form ["species"] permanently intact. Even the shrubs have acquired it, which obviously procreate and also are nourished and get their increase; since they are embedded in nourishment all the time, fastened by very deep roots, and are not suited for movement, they produce offspring from themselves without intercourse with another. Nature, the cause of this, endowed plants with joint sex, of male and female, so that they possessed the powers of male and female permanently mixed together.

[P153] But animals do not devote themselves just to procreation and nutrition, but have in addition a share of sense and knowledge, and being constituted for some other more notable functions, are divided into male and female sex[es]. In this way they devote themselves better to some other more excellent functions of knowledge, and not being completely attached to their food, they throw themselves into procreation with all their strength. So if they are obliged at any time to procreate, they must unite and, as Aristotle says, from the two of them, so to speak, one animal is made. Thus it is impossible for either a male by himself or a female alone from herself to produce an animal perfectly, although often she brings forth a crude unfinished mass, something we have noted in connection with a mole and the eggs of hens that our people have called wind-eggs. They are

enim sunt et irrita, quòd maris societate sit opus, qui procreationem perficiat. Rursum neque omnis in mare potestas gignendi sita est, vt qui procreationis locum non habeat. Ergo quum in plantis tum in animantibus vtroque sexu est opus: foemina quae corpus et materiam, mare qui animam speciémque conferat. Est enim mas, à quo motus procreationísque origo manat: foemina verò quae materiam segetémque subministrat: quapropter mas id animal est quod in altero gignit: foemina verò quod in seipso. Hisce de causis mas et foemina tum facultate, tum quibusdam corporis partibus, quae ad procreationem atque coitum accommodantur, inter se plurimum discordant: hinc Aristoteles generandi principia facultate distincta constituit. Quum autem in procreationem incumbunt, fieri certè nequit vt inuicem omnino misceantur atque confundantur, vti neque ipsa illarum principia. Non enim quemadmodum ex veteri cicada aut ex phoenice nouum nasci praedicant, sic ex mare et foemina coniunctim confusis aut intereuntibus, nouus homo progignitur. At verò quum complexu coitúque generent, necesse est saltem ab vtroque materiam quandam emitti et conferri, in qua illorum vis et potestas continetur: atque tanquam confluentibus principiorum et facultatum vicariis aut instrumentis, tertium quippiam gigni. Est autem ea materia vtriusque semen, in quo tametsi actu et reipsa mas et foemina minimè comparent, viribus tamen et potestate insunt, vti mox conspicuè cernetur. Quamobrem aliquispian id rectè nostri ortus verum proximumque principium statuerit. Semen igitur est ex quo primo oriuntur ea quae secundum naturam constituuntur, non quidem vt ex materia, sed vt ex motus efficiente principio. Primam seminis naturam atque rationem perscrutaturus Aristoteles, demonstrat planè id nec corporis nostri partem esse, nec alimentum, nec colliquefactum quippiam: concludens propterea id prorsum in reliquiis et excrementis haberi. Excrementum appellat reliquias alimenti: quae profectò aut inutiles sunt et ad nutriendum prorsus ineptae, aut certè vtilis quae sola copia superfluant. Atqui semen non inutile excrementum esse inde constat, quòd iis qui vel ex aetate vel ex morbo pessimè se habent, inutilis excrementi plurimum inest: seminis verò nihil vel certè minimum, et si quid è seminis vasis emittitur, id prorsus infoecundum est, nec quicquam constituere potest ob eluuii illius permistionem. Ergo (inquit) vtilis cuiuspiam excrementi portio quaedam semen est. Omnium autem vtilissimum atque purissimum est vltimum, ex quo iam vnumquodque membrum alimentum capessit atque sustinetur. Id enim omnino paucum ex plurimo relinquitur alimento. Dum igitur purior ac planè confectus sanguis in membra

infertile, because association with the male is needed for him to bring about procreation. On the other hand, not all the potentiality for bringing into being is located in the male, since he has no site for procreation. Therefore, both in plants and in animals, there is need for both sexes: the female's contribution is the body and material, the male's the soul and form. It is from the male that the origin of movement and procreation springs; the female supplies the material and the soil ["seges"]. So the male is the animal that creates in another one: the female the animal that creates in herself. For these reasons male and female differ markedly both in faculty and in certain parts of the body that are concerned in procreation and coitus; hence Aristotle established principles of generation separated by faculty. And when they [the faculties] apply themselves to procreation, it is impossible for them to be totally intermingled together, nor their actual principles either. People declare that from an old cicada or a phoenix a new one is born, but it is not in this way that a new human being is procreated from male and female combining together or perishing. In contrast, since they engender by embracing and coitus, it is necessary at all events that some material should be ejected and contributed by each, containing their power and potentiality. And with the meeting, as it were, of the substitutes or instruments of the principles and faculties, a third entity is generated. The material is the semen of both, in which nevertheless male and female make very little appearance in reality ["actu et reipsa"], but are present in powers and potentiality, as will soon be clearly seen. Consequently anyone was right to have taken this as the true and immediate principle of our origin. The semen is the original source from which things established according to nature first arise, not taking it as the material, but as the effective principle of movement. Aristotle, setting out to examine the primary nature and theory of semen, shows clearly that it is not a part of our body, nor food, nor something liquefied, concluding therefore that it stands entirely among the leftovers and refuse. He calls the leftovers of food "refuse"; these are undoubtedly either useless and quite unfit for nutriment, or of use at all events if they overflow through abundance alone. However, it is accepted that semen is not useless refuse, because in those who are in very poor condition through old age or disease, there is a great deal of useless refuse, but no semen, or anyway very little, and if any is emitted from the seminal vessels, it is totally infertile, and cannot amount to anything because of contamination with that rubbish. Therefore, says he, semen is a portion of some useful refuse. The most useful and pure of all is the last, from which each single limb takes nourishment and support. This entirely small amount is left over from a great deal of nourishment. And so, during the distribution of purer and entirely prepared blood into the limbs, and

distribuitur, accedénsque illis assimilatur, postremae concoctionis atque etiam nutritionis redundans et superfluens vtile alimentum, excrementum etiam appellamus, id autem seminis est materia. Semen igitur excrementum est et residuum alimenti vtilis atque vltimi. Id putat Aristoteles sanguinem esse, hoc indicio, quòd si vi nimioque conatu reddatur, nondum facultate testium plenè conuersum, vt iis accidit qui supra modum rei venereae indulgent, cruentum id plerunque prodeat. Imò et in spermaticis vasis cruentum id plerunque animaduertitur. Aristoteles semen ait magnam vim ob id obtinere, quòd ad partes corporis accedens, similem atque proximum alimentum substantiam et facultatem conquisiuit: vtrunque enim iam partis vim et naturam accepit. Itaque semen aut manus aut faciei aut etiam totius animalis, manum indefinitam aut faciem, aut animal totum indefinitum esse colligit, et quale vnumquodque illorum reuera iam est, tale et semen posse [P154] effici. Vt autem id portio quaedam sit vltimi alimenti, vtque in solidis quibusque particulis gignatur, hoc loco fusiùs aperiendum.

Seminis materiam in solidis partibus progigni, vtque ab illis testium vi discernatur. Cap. II.

PRODITUM QUIDEM suprà iam est et rationibus confirmatum, partes omnes corporis sanguine nutriri: ex quo corporis (simplex enim non est et vnusmodi) vnaquaeque pars quicquid sibi conueniens est et familiare prolicit. Id halitus specie tractum, mox vnaquaeque pars mutat et conuertit, ínque suam naturam demum perducit: ita enim particula nutritionem perficit, dum appositum alimentum perfectè sibi assimilât, et in suam naturam substantiámque mutat. Qualis itaque est cuiusque partis substantia, tale prorsus euadet et illius alimentum. Prima autem solidarum partium substantia ex semine constituitur ac gignitur, vt posthac erit apertius. Omnis igitur alimenti illarum substantia, in seminis naturam atque materiam facessit. Non ex alia materia procreatae sunt particulae, ex alia verò alimentum et vitam capessunt. Atqui partes omnes solidae ex semine ortum habent: omnes ergo aluntur semine. Rursum pars vnaquaeque σπερματικῇ dum nutritur, simile ei generat et resarcit quod fluore dissipatum est: at dissipatum est quippiam spermaticum, ergo spermaticum erit quod in eius locum sufficitur: id autem proximum est alimentum et sanguinis pars purissima pleniùsque confecta. Hoc iam fiat obseruationum meditatione planius. Vasa seminis quae multis anfractibus in

its addition and assimilation to them, the useful nutriment left over from the final concoction and the nourishing too is what we also call refuse, and is the material of semen. Thus semen is refuse and the residue of useful final nutriment. This is what Aristotle thinks is blood, on the evidence that if it is expelled with force and extreme effort, before full conversion by the faculty of the testicles, as happens to those who overindulge in sexual intercourse, it often comes out bloodstained. What is more, it is often visibly bloody in the spermatic vessels too. Aristotle says that semen possesses great power because on reaching parts of the body, it searches out a substance and a faculty like the nearest nutriment, for each [of these two] has already received the power and nature of the part. And so he deduces that the semen of the hand or the face or the whole animal is an undefined hand or face, or a whole undefined animal, and semen can be [P154] created of the sort that each of these already really is. How it may be a portion of the final nutriment, and be generated in each small solid part, will be disclosed in more detail here.

Chapter 2. The material of semen is generated in the solid parts, and how it is separated from them by the power of the testicles.

IT HAS already been stated above and confirmed by arguments that all the parts of the body are nourished by blood; from blood each part of the body (the body is not simple and uniform) lures out everything that is suited and congenial to it. It is extracted in the form of a vapor, and each single part soon alters it and ends by drawing it into its own nature. Thus a part completes its nutrition while completely assimilating the attached food to itself, and changing it into its own nature and substance. And so the food of each part will emerge completely of the sort that its substance is. The initial substance of the solid parts is generated from the semen, as will later become plainer. So all the substance of the nutriment of these parts departs into the nature and material of the semen. It is not the case that the parts are created from one material, and grasp their nutriment and life from another material. And what is more, all the solid parts have their origin from semen; therefore they are all nourished from semen. Again, while each spermatic part is getting nourishment, it generates a similar replacement for what has been dispersed by flux: what has been dispersed is something spermatic, so its replacement will be spermatic, and is the immediate food, and the purest and more completely prepared part of the blood. This may now become clearer through reflection on the points made ["observations"]. If you carefully observe the seminal vessels that proceed with many windings into

testes feruntur, si diligenter contemplare, conspicias sanguinem modicè iam albescentem continere, qui tamen nondum testes attingit. Hic cùm non è testibus eò refluxerit, argumentum est haec vasa ex sanguine diutius concepto semen quodammodo conficere: atque dum sanguinem in suam naturam vertere nituntur, hunc prius in semen commutare. pollent [*sic*] itaque haec vi quadam seminis effectrice. Atqui seminis vasa inter venas habentur, et communem cum eis substantiam acceperunt, neque igitur aliis venis per corpus vniuersum dispersis, vis et natura deerit seminis gignendi. Si qua alia corporis regione venae similiter atque haec vasa flexuosae haberentur, posset in eis multò faciliùs humor similis animaduerti. Et certè in omnibus venis talis quidam verè inest, qui per eorum tunicas insertus, proximum sit eis alimentum. Iam verò si venae hoc muneris et dignitatis à natura sunt adeptae vt semen generent, maiori profectò ratione in arteriis, nervis, membranis, et in ossibus, eadem vis insidebit, quòd haec spermatica magis sint quàm venae. At nequis fortè contentionis aestu conetur quas proposui rationes diluere, dicátque nec vero semine spermaticas partes nutriri, nec id verum semen esse quod in spermaticis vasis reconditur: nihil equidem eiusmodi rationibus efficere contendebam, sed id duntaxat quicquid est, propius quàm sanguinem ad seminis vim et naturam accedere. Siue igitur id nondum semen, siue inchoatum crudúmque semen appellet: satis supérque factum putabo si docuero, proximum id vnum partium nutrimentum, quod Aristoteli vtile ac vltimum dici solet, tum partium alendarum, tum verò seminis gignendi materiam suffici. Quae purior est in sanguine portio alendis partibus familiaris et accommodata, ea vt facìle et citò alit, ita cùm tenuis sit plenáque spiritus, quàm mox in seminis materiam conuertitur. Huius quidpiam solidis partibus semper assistit, sempérque sanguini spermaticus humor roris modo inspergitur. Hic tametsi vera est materia, non tamen simplex est et vnusmodi, sed alius aliam vim et naturam accepit, ex varia partis natura à qua mutatus est. Qua autem is ratione secretus, in testes adducatur hoc loco narrandum est. Vt in liene vis quaedam inest ad prolectandum melancholicum humorem comparata, in renibus alia quae vrinam alliciat, ita in testibus conuenit vim quandam inesse qua seminis materiam sibi quidem perquam familiarem et idoneam, tanquam proprium

the testicles, you will notice that they contain blood already turning moderately white, even before reaching the testicles. Since it has not flowed back to there from the testicles, this is evidence that these vessels somehow make semen out of blood they have held for some time, and while they are striving to convert the blood into their own nature, they alter it first into semen. And so they are significant through [having] some power that creates semen. However, the seminal vessels lie between veins, and possess a substance in common with them, and therefore the power and nature of generating semen will not be lacking in the other veins dispersed throughout the body. If veins are present in any other part of the body that twist like these vessels, a similar humor could be noticed much more easily in them. Certainly a humor of the sort is really present in them all, to be the immediate food for them when introduced through their coats. But now, supposing the veins have secured from nature the function and status of generating semen, surely, a fortiori [*maiori ratione*], the same power will reside in arteries, nerves, membranes, and bones, because these are more spermatic than veins are.

But in case anyone in the heat of argument attempts to refute the reasoning I have set forth, and says that spermatic parts are not nourished by real semen, nor is it real semen that is stored in the spermatic vessels: I was not striving to prove anything of the kind by reasoning, but simply [to show that] whatever it is, it gets nearer than blood to the power and nature of semen. So one might call it future [*nondum*] semen, or crude semen in process of development [*inchoatum crudumque*]; I will think enough and more than enough has been done if I have managed to teach that the single nearest nutriment of the parts, which Aristotle used to call the useful and final one, is the material supplied both for nourishing the parts and for the generation of semen. The purer portion of it in the blood, comfortably suited for the nourishment of the parts, nourishes easily and quickly, and is rarefied and full of spirit, and so is rapidly converted into the material of semen. Something of it is always situated at the solid parts, and spermatic humor is always besprinkling the blood like dew. Even though this is genuine material, it is not simple and uniform, but one [humor] receives one power and nature, another another, because of the differing nature of the part by which it was transformed.

Now we are to describe the basis on which it is separated and drawn into the testicles. In the spleen a power is provided for enticing melancholic humor, and there is another in the kidneys that attracts urine: in the same way a power is acknowledged in the testicles enabling them to tempt and draw into themselves the material of semen, very intimate and appropriate, as their own closely

coniunctumque alimentum inuitent et attrahant. Cum autem magna sit et vehemens haec eorum vis, quae in corpus vniuersum permanat, ceu mox aliis multis rationibus planum fiet, ij nimirum tum vberiore materiam quam sibi opus est, tum verò hanc ex vniuerso corpore elicient et euocabunt. Vt ergo iecur ex intesti-[P155] nis succum rapit per venas mesenterij, sic testes per seminis vasa materiam sugunt à vena caua, quae lumbis et renibus assistit, haec verò ab omnibus circumiectis venis grandioribus, hae à minutis, quae iam vix capilli magnitudinem adaequant, et quae partes singulas alunt. Ea enim attractio manet ac persistit dum vasa et testes impleantur, neque enim prius intermittit, quam testes copia turgeant atque saturentur: inaniti enim ex locis plenioribus veluti eripientes violenter euellunt. Ex his potest intelligi Aristotelem iure optimo falsi insimulasse Polybium, qui libro de natura seminis Hippocrati ascripto, hanc ex toto corpore secretionem in solo concubitu fieri censuerit, ipsumque semen ceu colliquefactum quiddam esse, motu agitationeque secretum: neque id in vasis aut testibus aliquando subsistere et commorari, vt tempore mutationem subeat. In haec autem quoniam ille plurima scitè attulit, satis erit subiecta observatio quae id funditus euertat. Animante enim quae [*sic*] à venere diutius abstinuerit dissecta, copiosissimum crassissimumque [*sic*] semen comperitur, quo et vasa et testes et epididymis turgent: quod non nisi summa vi trahendi testium fieri potuit. Contrà verò accidit si quod animal effrenata et indomita venere feratur. Testes enim è vasorum involucro rapient, eaque prorsus exinanient, vt si demum consectionem fieri contingat, nihil omnino seminis inesse deprehendatur. Ergo quodcunque in coitu semen emittitur, id necesse est congestum prius fuerit et coaceruatum, tractumque vi praepotente testium. Obscurior alia ac scopulosior dubitatio hîc difficiles explicatus habet. Multa enim plerique proferunt, quibus persuadeant seminis quam diximus materiam, et in partibus singulis progigni, et ab iis quotquot sunt in testes confluere, alioqui inutile id fore ac minimè foecundum. Quae tametsi firmissimis rationibus Aristoteles visus est confringere, alias tamen subiungam, ex quibus id nequaquam fieri posse demonstrem. Si enim de minima quaque particula seminis quicquam decederet, cum nihil extare possit minus minimo, necesse esset vnico concubitu vniuersum corpus in semen quasi liquefactum diffundi. Quoniam verò minimae particulae quam cogitatione potius quam

associated nutriment. Since this power of theirs, pervading the whole body (as will soon become clear from many other arguments), is great and strong, they will presumably lure and summon out more abundant material than they require, and do so from the whole of the body. Therefore, as the liver grasps [P155] juice from the intestines through the mesenteric veins, so do the testicles suck material through the seminal vessels from the vena cava that adjoins the loins and kidneys; the vena cava sucks it from all the surrounding larger veins, and they ["hae"] from tiny ones, barely the size of a hair, that nourish individual parts. This pull persists so long as the vessels and testicles are being filled, and does not break off until the testes are swollen and saturated with abundance; when they are emptied, they snatch violently from places that are fuller, like muggers ["eripientes"]. From this one can understand that Aristotle was absolutely right to accuse Polybius¹ of falsehood, because in the book on the nature of semen ascribed to Hippocrates, he considered that this separation out of the whole body happened only during sexual intercourse, and the semen itself was a kind of liquefied thing, separated off by vigorous movement: it did not loiter occasionally in the vessels or testicles, to undergo change over time. Since [although?] he brought much learning to bear on these matters, the following ["subiecta"] point will be enough to overturn his view ["id"] entirely. When an animal is dissected that has abstained from sexual intercourse for some time, very abundant and thick semen will be found, bulging the vessels and testicles and epididymis; this could not occur without a very great testicular power of drawing in. The converse occurs if any animal is carried along by unbridled lust. The testicles will grab from the vascular sheath, emptying the vessels completely, so that if a dissection happens to be made in the end, no semen at all is found. Therefore, whatever semen is ejected at coitus must have been accumulated previously, and drawn along by the outstanding power of the testicles.

Another more baffling and thorny ["scopulosior"] uncertainty entails difficult explanations at this point. Most people bring forward much to persuade us, both that the material of semen we mentioned is generated in the individual parts, and that it runs from them (however many they are) to meet in the testicles; otherwise it would be useless and hardly fertile. Although Aristotle seemed to demolish these [views] by the most solid arguments, I shall attach others, to show from them that it could not happen. If some semen were withdrawn from each smallest particle of the body, since nothing can exist smaller than the smallest, at a single act of sexual intercourse all of the body must spread out into (as it were) liquefied semen. But since no part can be broken off from the smallest particle that we can grasp by thought rather than

sensu comprehendimus, nullum potest fragmentum haberi, non potest de illa quicquam decedere. Neque praeterea ex omnibus sensu manifestis tum simplicibus, tum compositis quippiam secernitur ad seminis constitutionem: copiosum enim id colligi necesse foret quod foecundum euadit: nec fieri posset vt tantula quae eiicitur substantia vim haberet ad procreandum foetum, quòd è singulis corporis partibus quippiam accepisse non possit. Quinetiam semen totum sensu simplex apparet, et vnaquaeque eius portio foecunda vt totum esse ex iis animalibus intelligitur, quae vnico coitu et ex paucò semine multiplices foetus procreant. Ergo cùm quaelibet seminis portio totius vim habeat, qua corpus vniuersum conformet, non sic potuit totum semen à toto corpore dimanare, vt de vnaquaque parte fiat partis similis decessio. Quamobrem rectè censuit Aristoteles, seminis materiam non à toto corpore demitti. At nihilominus hanc necessum est de cerebro, de corde, et iecore, quae tria sunt principia, decedere: plurimum autem de cerebro: hoc quidem illius argumentum est, quòd cui vnumquodlibet istorum grauem offensionem acceperit, infocundus is reddetur: quemadmodum si leuius erit vitium, prolem suscitabit aegra infirmaque valetudine. Ex quo fit, vt iis venis et arteriis quae ponè aures sunt resectis aut exustis, foecunditas adimatur. Seminis ergo materiam ex toto deriuari atque dimanare sic accipiendum, vt ex illius principiis principibusque partibus necessariò profluat. Sunt qui putent hanc non modò ex principiis, sed ex omnibus quoque similaribus partibus secerni: non quidem ex vnoquoque osse vel neruo, sed ex aliquo osse, ex neruo, ex membrana, ex cartilagine quiddam in seminis materiam conferri. Deinde verò quod à neruo vel ab osse profluxit, non modò illius, sed etiam omnis nerui vel ossis in conceptu materiam fieri. Proinde ex tantulo semine tanquam ex materia, similes omnes partes effici: idque eius facultatis opera, quae in semine sita omnia conformat. Non desunt qui seminis materiam, vltimi quidem alimenti superantem partem esse dicant, quae tamen non à toto decedat, sed contrà quae ad totum esset proximè accessura.

De testiculis et eorum praestantia. Cap. III.

[P156] MAGNAM QUIDEM vim esse testiculorum seminis secretio decessióque docet, qua ij ex vniuerso corpore, materiam proluciant: at multò maximam declarant tum vires, quas ij corpori impertiunt, tum verò completa seminis absolutio.

by sense, nothing can be withdrawn from it. What is more, from everything manifest to sense, both simple and composite, nothing is separated off towards the constitution of semen. What is fertile would have to be collected in quantity, and so small an amount of substance as is ejaculated could not possess the power to procreate a fetus, because it could not receive anything from the individual parts of the body. Furthermore, the whole semen looks uniform to our senses, and each single part is fertile like the whole, as is seen from the animals that produce multiple fetuses from a single coitus and small amount of semen. So, since any part of the semen has the power of the whole, by which it fashions a whole body, the whole semen could not percolate from the whole body in such a way that from each part the withdrawal of a similar part takes place. So Aristotle was right to hold that the material of the semen was not drawn from the whole body. However, the material must be withdrawn from ["decedere"] brain, heart, and liver, the three principles ["principia"], and most from brain; his argument is that someone in whom any of these has sustained severe impairment will be rendered infertile; similarly, if the defect is less serious, he will give rise to offspring in poor and precarious health. This is why those who have the veins and arteries behind the ears cut or burnt out lose their fertility.²

Therefore, we are to accept that the material of semen stems from the whole, in the sense that it necessarily flows forth from the sources and main parts of that whole. Some think it is separated out not just from the main parts, but from all the similar parts too, and that something is contributed to the material of the semen is not from each single bone or nerve, but from some bone, nerve, membrane, and cartilage. And next, that what has flowed from nerve or bone becomes in conception the material not just for that one, but for every nerve or bone. All the similar parts [they think] are made out of a tiny amount of semen as material: by the agency of the faculty that is situated in the semen and fashions everything. There are people who say that the material of semen is a dominant part of the ultimate nutriment, yet does not proceed from the whole, but is on the other hand what is going to be added next to the whole.

Chapter 3. The testicles and their preeminence.

[P156] THE SEPARATION and withdrawal of semen teaches that the power of the testicles is great, the power by which they entice material out of all of the body. But it is revealed as much the greatest by the powers that they [the testicles] convey to the body, as well as by the final perfection of the semen.

Quibus enim execti sunt testes, etiamsi eorum vasa laesa non sint, vis illa et facultas effectrix seminis occumbit: vt licet ij aetate sint adulta atque florente, non tamen rei venereae voluptate oblectationéque teneri possint, omnisque generandi potestas sit erepta. Simul his extinguí deprehenditur masculus et virilis animus, totáque viriditas et flos roboris cum testibus excinditur. Quinetiam eorum natura in frigidiorém conuertitur, neque sanguis bonus, neque color suavis aut formae dignitas apparet: arteriae paruum et imbecillum, quemadmodum in senibus pulsum edunt: corpus albescit, graue, iners, opimúmque redditur et minus hirsutum, atque (vt semel dicam) effoetam fit, molle et effoeminatum. Neque verò hanc solùm roboris temperamentique mutationem incidere, verunetiam propriae substantiae naturam inuerti hinc intelligitur, quòd castratorum animalium carnes quadam dulcedine et suauitate gustatum mouent, quae autem è non castratis acceptae fuerint, tum odore tum sapore testiculos referunt, euomúntque graue quoddam virus acerbitatis suae. Si testiculis exectis, totius corporis robur, temperamentum, propriáque substantia inuertitur atque mutatur, testiculi dum aderant, istorum authores erant et effectores. Neque tantae mutationis et praestantiae causa sunt et principium, vt quidam existimant, quòd in se illabentem ex vniuerso corpore tum calorem, tum spiritum, densa, compactáque substantia tanquam speculum radios in vniuersum corpus refundant. Neque quòd in illis congestum semen, robur et calorem eiusmodi corpori impertiat: quanquam profectò illa non parum augere hinc animaduertitur, quòd cùm affluit et redundat, turgescens id impetu ardoréque corpus perturbat, excretum autem hoc placidum, lene, tranquillúmque reddit. Sed hoc roboris et caloris ex se propriáque facultate obtinent, hásque suas vires in omne corpus effundunt, quemadmodum cerebrum nervis tum sentiendi tum mouendi vim, cor arteriis pulsandi facultatem impertit. Ex quibus intelligi potest testiculos magno subsidio corpori venire, quo perfectius id et salubrius vitam agat, esséque ad meliorem vitae statum et conditionem vtiles. Porrò autem ad generis conseruationem, magna quidem est eorum necessitas, vt idcirco in principum partium numero censeantur. At certè Aristoteles hoc vno argumento, quòd quaedam animalia, vt serpentes et pisces omnes, semen foecundum profundant, quibus tamen testes à natura denegati sunt, visus est existimasse hos ad seminis confectionem et ad generis custodiam principatum non habere. Si quae tamen eiusmodi sunt, vt sine semine generent, quale esse perhibent insectorum genus:

Those whose testicles have been excised, even without damage to the vessels, lose that power and faculty for making semen; the result is that they are unable to engage in the pleasure of sexual intercourse, and all power of procreation is gone, even though they are adult and in their prime. At the same time the virile male mind ["animus"] turns out to be quenched, and their whole youthful vigor and the heyday of their strength are destroyed. Further, their nature is altered to a colder one, and good blood, a pleasing color or excellence of form are not to be seen. Their arteries display a small weak pulse, like that in the elderly; their body grows pale, turns heavy, idle, obese, and less hairy, and (to say so once and for all) becomes feeble, soft, and unmanly. That this is not just the onset of a change of strength or temperament, but perversion of the nature of their own substance, is shown by the fact that the flesh of castrated animals stimulates taste by a sort of charming sweetness, but flesh acquired from animals not castrated has an odor and taste reminiscent of testicles, and spews out a sort of unwholesome venom of their sourness. If excision of the testicles perverts and alters the whole body's strength, the temperament, and the particular substance, then while the testicles were present, they were the originators of these and brought them about. Though some people think so, it is not because with their close-knit substance they reflect [back] into the whole body both the heat and the spirit that steal into them from the whole body, as a mirror reflects rays, that they are the cause and source of such a great change and preeminence. Nor is it because the semen stored in them bestows strength and heat of this sort on the body, though it is certainly noticeable that these increase a good deal, since when semen abounds and is plentiful, its swelling disturbs the body by its heated impact; but when it is excreted it makes the body calm and tranquil. But they [evidently the testicles] acquire this much of strength and heat from themselves and their own faculty, and pour out these powers of theirs into all the body, in the way that the brain bestows on the nerves the power of sensing and moving, and the heart bestows on the arteries the faculty of pulsating. It follows from this that the testicles are of great assistance to the body in its pursuit of a more perfect and wholesome life, and are of use towards a better state of life; and furthermore, there is great need of them for the preservation of the race ["generis"], and hence they are reckoned among the main parts.

Certainly, however, Aristotle appeared to have thought that they did not possess supremacy in the manufacture of semen and the preservation of the race, his argument being simply that certain animals, such as all serpents and fishes, emit fertile semen, although denied testicles by nature. But if there are some of a sort to procreate without semen, as the race of insects is reputed to do,

aut si quae emisso semine sine testiculis generant, vt pisces atque serpentes, omnium procreandi rationem mancam atque imperfectam censemus, quippe quae non nisi temporis longinquitate perfici potest. In reliquis autem animalibus, quae modo quodam perfectiori generant, et quae in procreationem, non quemadmodum insecta et muscae, tanquam affixa diutius incumbunt, testes additi sunt, qui pleniùs semen excolerent et complerent, ídque foras profunderent: nullam enim in his posse creationem sine testibus perfici, vna experientia satis confirmat. Ergo non (quemadmodum Aristotelis² fert opinio) testes melioris duntaxat vsus gratia conditi sunt, neque vt motum seminis stabiliorem faciant, neque vt pondera telis textorum sic vasis seminis adiecti sunt, vt illa contendant. Putauit siquidem castratos idcirco generare non posse, quòd exectis testiculis vasa seminis intrò se contrahant, occludantúrque eorum viae, per quas euadere iam semen non possit. At verò quid de iis sentiet, quibus non execti, sed attriti duntaxat sunt testes, aut quibus immodicè refrixerunt, aut alia quapiam intemperie aut vitio aut morbo affecti sunt, velut in gonorrhoea? His enim tametsi reliquum corpus firma est et incorrupta sanitate, et viae satis patent, vt per eas abundè id possit emanare, quicquid tamen effluit, imperfectum est et minimè foecundum. Quamobrem efficiendi se-[P157] minis testes primi sunt authores, vasa deferentia id quodammodo praeparant, iaculantia verò perficiunt. Etenim in his animalibus quae sibi diutius à coitu temperarunt, omnia conferta semine videntur, sed quod (vt dixi) concoctionis varietate distinctum sit: hoc autem qua ratione fiat, explicandum excutiendúmque planiùs est. Vt seminis materia quam è singulis particulis paulatim testes magna vi traxerunt, in flexuosis vasorum anfractibus longo viae tractu haeret cunctatúrque diutius: ita in arteriis quae illis anfractu quodam substratae sunt, spiritus quasi irretitus subsistit atque retinetur. Hac mora et cunctatione vtraque vasa nituntur quicquid continent tanquam alimentum, sensim in similem sibi speciem mutare: et vt illius colorem ita planè et substantiam totam paulatim conuertere. Quum ita praeparatus humor in postremos illos anfractus qui testiculos inuoluunt et circumplicant, tractus delatúsque fuerit, coquitur, aptúsque perficitur ad animalis procreationem: ídque tum robore et calore eorum vasorum quae testes ambiunt, tum verò ipsorum testium ingenita vi. Glandes enim cùm sint, et spongiae modò rari, complures fistulae seminis confertae in eos ex vasis propagantur, per quas susceptum humorem propria vi conficiunt.

i. de generatione
animal.

or some that procreate by emission of semen without testicles, like fish and serpents, we reckon the whole basis of procreation is crippled and incomplete, for it can only be performed over a long period of time. But in the rest of the animals, which procreate in a rather more perfect fashion, and which lie for some time as if stuck together for procreation, unlike the insects and flies, testes are introduced, to develop and perfect the semen more fully, and to pour it forth externally; in these, experience alone adequately proves that no procreation is performed without testicles. It is therefore not true that (as Aristotle's view runs) the testicles were instituted just for the sake of a better practice, or to steady the movement of semen, nor were they attached to the seminal vessels to keep them taut, as weights are attached to the webs of textiles; he thought that the reason castrated creatures did not procreate was that after the testicles have been cut out, the seminal vessels contract into themselves, and their channels are blocked, so that the semen cannot travel out along them. What then will he think of those whose testicles are not cut out but simply crushed, or excessively chilled, or affected by some other imbalance or fault or disease, as in gonorrhea? Although the rest of their body is strong and of unsullied health, and the channels are open enough to convey plenty of semen, yet all that runs out is imperfect and barely fertile. Therefore, the [P157] testicles are the prime originators of the making of semen, the vasa deferentia prepare it in some way, and the ejaculating vessels bring it to perfection. For in animals that have refrained from coitus for some time, everything seems crammed with semen, but semen of a sort to vary in the diversity of its concoction; on what basis this may happen needs to be explained in more detail. The material of semen, pulled out of the individual parts gradually with great power by the testicles, lingers for some time during the long course of its path in the twisting bends of the vessels; in the same way, in the arteries underlying these bends in a sort of winding route, spirit is as it were entangled, stops short, and is held back. During this interval of delay both sets of vessels endeavor to handle their contents as nutriment and change it gradually into a form like theirs, and little by little to convert its color, and clearly also its whole substance. When the humor, thus prepared, has been drawn and transferred into the final bends that enwrap the testicles, it is concocted ["coquitor"] and rendered suitable for the animal's procreation; this is achieved both by the strength and heat of the vessels surrounding the testicles, and by the inherent power of the testicles themselves. As they are glands, and of loose texture like a sponge, several tubes full of semen are extended into them from the vessels, through which they prepare by their own power the humor they have taken up.

Quaenam est seminis compositio, quid testes ad eius confectionem conferant. Cap. IIII.

SEMINIS ERGO materiam è vena caua elici, idque perfectam tum coloris tum substantiae mutationem in testibus habere, vna sensuum fide confirmatum putamus. At verò in semine quod foecundum est et ad procreationem comparatum, praeter eam materiam speciem quandam haberi, quae spiritus et caloris vim summam obtineat, argumentis et rationibus oportet docere, iisque ex naturae arcanis et ex recondita aliorum animantium conditione depromptis. In iis ergo quae semen non emittunt (quod genus maximè insectorum est) foemina particulam sui quampiam inserit in marem, et veluti materiam ad opificem adhibet, in hanc deinde mas vapore quodam vitae vim et facultatem coniicit. Diu coit genus id animalium, quousque constituatur aliquid: tam imbecilla enim his inest vis procreatrix, vt si quid quasi medium intercedat, nihil quicquam possit efficere: sed eam necesse est per se et proximè animal condere, et propriam cuiusque membri naturam nullius seminis aut instrumenti interuentu, sibi simile in alio membrum effingere. At in perfectioribus animantibus quae non modò procreationis, sed praestantioris cognitionis gratia consistunt, mas tanto facultatis robore praeditus est, vt cùm de se vim quandam cum seminis materia in foeminam emisit, possit ipse vel absens seminis interposito prolem gignere. Itaque quodcunque foecundum est et vtile semen, simplex id non est, sed vtique compositum, materiámque habet vltimi alimenti excrementum, et in hac facultatem quandam opificem, quae tota est aetherea spiritúsque plena. Hanc insitam non esse materiae id planè demonstrat, quòd in semine appellato, quod per morbum ceu per gonorrhoeam praeter voluntatem excidit, nulla facultas inest, sed id omnino excrementum est ad id gignendi neutiquam munus accommodatum. Hoc nemo rectè semen nuncupare possit, nisi fortè inducta homonymia: quemadmodum manum quae ab omni animae facultate destituitur, manum: hominémque demortuum hominem solent appellare. Caeterùm quae in foecundo semine facultas consistit, ea est quae per se agit, omnisque motionis est principium: seminis autem corpore et materia vis ea tanquam instrumento vtitur, quemadmodum anima vt apprehendat manum, et faber securim adhibet, vt ex ligno lectum arte construat. Vt igitur anima manum, haec deinde materiam ex qua quippiam efficit, mouet ac impellit, ita in his animantibus quae semen profundunt, hoc quidem proximè mouet et agit, sed à propria quadam vi et energia

Chapter 4. The composition of semen, and what the testicles contribute to its making.

WE CONSIDER it therefore proven on the evidence of the senses alone that the material of semen is enticed out of the vena cava, and the semen undergoes in the testicles a complete change both of color and of substance. But in semen that is fertile and ready for procreation, there is besides that material a form that possesses the highest power of spirit and heat, and this lesson should be taught by evidence and reasoning, derived from nature's secrets and from the hidden character of other animals. Accordingly, in those that do not emit semen (a kind consisting mostly of the insects), the female inserts some small part of herself into the male, and (so to speak) brings the material to the craftsman; then the male deposits the power and faculty of life into it, by a sort of vapor. In this kind ["genus"] of animal coitus is prolonged until something is produced, because the procreating power in them is so weak that if anything interferes, nothing at all can be achieved; the animal must on its own and very closely insert ["condere"] the power, and the particular nature of each limb must fashion a limb like itself in the other, with no semen or instrument intervening.

But in the more perfect animals, which exist not just for procreation but for a more excellent knowledge, the male is endowed with such great strength of faculty, that after emitting a power from himself into the female, along with the material of the semen, he can beget offspring even in his absence, through the introduction of semen.³ And so any semen that is fertile and of use is not simple, but absolutely composite, and has as its material the refuse of the final nutriment, and in that a creative ["opifex"] faculty, which is all ethereal and full of spirit. What clearly shows that it is not resident in the material is this, that in the so-called semen that emerges involuntarily through disease as it does through gonorrhea, there is no faculty, but it is entirely refuse, in no way suited to the function of begetting. No one could correctly call this semen, unless perhaps by invoking homonymy, in the way that people usually call a hand lacking all faculty of soul a "hand," and a dead man a "man." But the faculty present in fertile semen is one that acts on its own, and is the origin of all motion; that power employs the body and material of the semen as its instrument, in the way that the soul uses the hand to grasp, and the craftsman an axe, to build a bed skillfully out of timber. The soul moves and urges on the hand, and then the hand does the same to the material from which it makes something; in the same way, in animals that emit semen, the semen is the immediate mover and agent, but spurred on by its own power and by the energy ["energia"]

quam gerit incitatum. In quibus ergo quippiam constitui solet secreto profusó-
 que semine (non enim omnia, vt dixi, emittunt) non id quidem tanquam
 efficiens primarium et insitum generat, sed id quod primùm mouet. Virtus
 enim quae in seminis materia coërcetur, vitam impertit, et partes conformat,
 summa illius facultas, non ex mole, sed ex viribus spectanda. Cùm itaque duo in
 semine comprehensa teneantur, materia et facultas, illa quae patiendi vim habet
 non ab omnibus corporis partibus, à quibusdam tamen necessariò secernitur:
 haec verò quae prorsus est efficiens, [P158] ab vnaquaque vel minima demigrat,
 quod nonnulli hac verborum interpretatione explicant, semen non mole, sed
 viribus à toto defluere. Caeterùm qua via quáue ratione haec ex toto decessio
 fiat, vtque ex duobus illis vnum semen constet aperiendum. Seminis crassior
 materia, cùm solidis partibus apposita erat, ab eis generandi vim non con-
 quirebat, sed praeparationem duntaxat et patiendi constitutionem, ob quam
 facilè posset in illarum substantiam conuerti. Ea verò cùm ad testes rapitur, vim
 suam etiam tum retinet, et praeparationem habet, ex qua poterit aliquando in
 partium suae naturae materiam suffici atque substitui. Seminis materia quan-
 quam vasorum testiúmque vi exquisitè adeò coquatur, vt crassior albiórque
 euadat, nequaquam tamen semen inde absolutam foecunditatis naturam conse-
 qui potest, nisi magna vbertate spiritus influant, eíque materiae penitus confun-
 dantur. Quandoquidem horum causa arteriae ab aorta deductionem habent in
 testes, seminis vasa comitatae. Ex quo intelligi potest, per ea vasa materiam: per
 arterias verò formam et facultatem semini conferri. Per has quidem spiritus
 vitalis, per venas naturalis è iecore, per neruos animalis à cerebro et spinae
 medulla illabitur in testes. A caeteris autem particulis et ab vniuerso corpore
 credibile est nonnihil spiritus atque facultatis derepente in testes irruere, ídque
 valida agitatione corporis et perturbatione, quae in ipso fit coitu, cuius hoc esto
 indicium, quòd titillatio vehemens tum corpus vniuersum eximia voluptate
 afficit. Hae igitur vires et facultates quae cum spiritibus ex vniuerso corpore,
 maximè verò ex principibus partibus confluerunt, illi demum seminis materiae
 insident tanquam procreationis magistrae et opifices. Quapropter non testes
 semini vim tribuunt qua foecundum est, sed haec ab vniuerso corpore
 suscipitur.

it wields. In the animals in which something is usually established by semen separated and poured out (they do not all emit it, as I said), the semen does not beget as the primary implanted efficient thing, but is what does the moving first. The virtue that is confined in the material of semen, imparts life, and fashions the parts is the supreme faculty of it, remarkable not for its bulk ["moles"] but for its powers. And so, since material and faculty are both held in semen, the material, which has the power of being passive ["patiendi"], does not have to be secreted from all parts of the body, but from some of them; but the faculty, which is entirely efficient ["efficiens"], proceeds away [P158] from each single part, however small, which some explain by this verbal interpretation, that it is not by its bulk but by its powers that semen flows out from the whole.

But the path and the basis by which this withdrawal from the whole occurs must be clarified, and how a single semen is formed from these two [probably the material and the faculty]. When the thicker material of semen was attached to the solid parts, it was not looking to get the power of procreating from them, but just a preparation and a passive constitution ["patiendi constitutio"], in virtue of which it could easily be changed into their substance. While this is being carried off to the testicles, it still keeps its own power, and possesses a preparation that will enable it sometime to be supplied as a replacement into the material of parts [that are] of its own nature. Although the material of semen is so meticulously concocted by the power of the vessels and testicles as to become thicker and whiter, the semen cannot possibly thus attain the perfect nature of fertility, unless spirits enter in great profusion, and are thoroughly mingled with that material; for their sake there are arteries that draw off from the aorta into the testicles, accompanying the seminal vessels [testicular veins in the male, ovarian veins in the female]. From this it follows that material is contributed to the semen along these vessels, but form and faculty along the arteries. Along the arteries vital spirit glides into the testicles, along the veins natural spirit from the liver, along the nerves animal spirit from the brain and the spinal cord. From the rest of the parts and the body as a whole, it is credible that some spirit and faculty hasten suddenly into the testicles, in association with the vigorous bodily disturbance that occurs at coitus; let this be the evidence, that the powerful stimulation ["titillatio"] at that time causes the whole body to experience exceptional pleasure. So these powers and faculties that have gathered along with spirits from the whole body, but especially from the main parts, end in residence in that material of semen, as the controllers and fashioners of procreation. It is not then the testicles [alone] that provide the semen with the power by which it is fertile; this power is received from the whole of the body.

Quid est (inquies) quamobrem testes inter principes partes retulimus, et quid hi in semen conferunt? Non materiam, vt quae ex corporis alimento rapta haustaque est, non vires illas et facultates, vt quae ab vniuerso corpore cum spiritu dimanarunt. Quanam igitur eorum est efficientia? Ea sanè quod materiam seminis concoquunt, ac planè in alteram speciem conuertunt, simulque ei formam eam à qua semen est et appellatur (quemadmodum mammae lacti speciem) ex se ij tribuunt. Quinetiam suo illi calore spiritus quos ex corpore acceperunt, diligenter commiscent materiae, eorúmque facultates inserunt semini, et omnium temperatione vnum efficiunt, hácque ratione semen perficitur omnium viribus ornatum. Neque igitur facultas, neque spiritus generans in testibus collocandus est: sed haec propriè totius sunt corporis, eorum animalium exemplo quae vniuersi sui corporis calore et spiritu generant, nullo semine profuso. Neque in perfectis animantibus quae semine generant, vllus est spiritus qui generans dici meretur. Non enim vt cerebrum ex vitali animale spiritum producit, sic testiculi vim habent ingenitam, quae illapsos vndique spiritus in vnus generantis eiúsque simplicis naturam commutent; sed si quis est in nobis generandi spiritus, is coniunctio et confusio quaedam est omnium. Caeterùm qui contentione velit generantem vim ac spiritum testiculis attribuire, huncque ex multorum congressu simplicem esse factum, vix fortasse possit rationibus conuinci, quemadmodum neque si semen simplex ac prorsum vnusmodi, non ex multarum partium naturae dissimilis adhaesione compactum et coagmentatum pronuntiet. Vtcunque haec constituta stabilitaque fuerint, testes nihilominus iure possunt inter principes partes haberi: non quia singularis cuiuspiam animalis vitam, sed (quod praestantius est) quia eius vniuersum genus perpetuant, neque vnquam id vlla mortali necessitate sinunt occumbere.

De seminis natura, praestantia, et viribus, idque omnium tum spirituum, tum facultatum causa esse. Cap. V.

IAM VERÒ ad seminis contemplationem reuersi, ex procreationis modo scrutemur quanam illius substantia, et quae natura sit. Quodcunque absolute coactum coctúmque est, id vt colore album, ita et substantia crassum redditur, planèque imitatur vasorum ac testium naturam: cuiusmodi plaerunque ab animali grandinis specie prodire deprehenditur. Caeterùm non sicuti grando vel nix id frigoris vi concreuit,

Why then, you ask, have we included the testicles among the main parts, and what do they contribute to the semen? Not the material: it is seized and drawn from the body's food; not those powers and faculties, which have percolated along with spirit from the whole body. What then is their influence ["efficientia; of the testicles, evidently"]? Certainly this, that they concoct the material of the semen, and plainly change it into another form, and at the same time provide it from themselves with the form by which it is semen and is called semen (in the way that breasts give form to milk). Again, the spirits acquired from the body zealously mingle the material with their own heat, and implant their faculties in the semen, and make it one [yet] with the temperament of all, and on this basis semen is produced embellished with the powers of everything. So neither the faculty nor the generating spirit should be stationed in the testicles; these are properly features of the whole body, to judge by the animals that beget with the heat and spirit of their whole body, emitting no semen. Nor is there any spirit that deserves the name "generating," among the perfect animals that beget by semen. The brain produces animal spirit from vital spirit, but testicles differ and do not have an inherent power to convert the spirits inflowing from everywhere into the nature of one generating and simple spirit. If there is a spirit for generating in us, it is a sort of combination of them all.

But anyone who is quarrelsome, and would seek to impute the generating power and spirit to the testicles, and [to hold that] it is a simple one made from the assembling of many, could perhaps hardly be persuaded by arguments, just as he would not declare that semen is assembled by the adhesion of many parts of different nature, even if semen is not simple and entirely uniform. However these [points] have been established and settled, all the same the testicles can rightly be reckoned among the main parts, not because they perpetuate the life of any single animal, but because they perpetuate its whole kind ["genus"], a more excellent achievement, and never allow it to fall victim to any inevitable mortality.

Chapter 5. The nature, excellence, and powers of semen, and that it is the cause both of all spirits and of all faculties.

NOW LET us return to consider semen, and from the manner of procreation look into what its substance and nature are. Every ["semen"] that is perfectly put together and concocted is made both white in color and thick in substance, and clearly reproduces the nature of the vessels and testicles; most of this sort is found to emerge from the animal looking like hail. However, it did not congeal

sed ab ingenito et interiore [P159] vasorum ac testium calore. Neque tamen vti lac, ouum aut alia quaecunque multum terrenae substantiae permistum habent, coctione cogitur, in quibus vi caloris humore dissipato crassior portio subsistit. Nemo enim tam rudis est, qui semen quod planè aëreum aut potius aethereum est, inter haec terrena connumeret. Quid ergo restat? Vt aqua oleo permista, aut oui candidum diutius agitaturn, à coërcito flatu in spumae densae et albae ingentem tumorem exurgit, ita propemodum quod in nobis est semen calore cogitur et albescit. Testium enim calor spiritum vitalem ac reliquos tanquam concoctione exagitans, materiae seminis omni ex parte permiscet, cùmque sit ea materia non parum cohaerens et tenax, ab immixto spiritu facilè in spumam eamque densissimam turgescit, cuius tamen bullae cerni vix possint, vt neque in butyro. Ea certè de causa veteres fabulantur, Venerem ex spuma progeneratam fuisse, et Graecis Ἀφροδίτη ἀπὸ τοῦ ἀφροῦ quasi spumans Dea Venus est appellata, et ἀφροδισιάζειν despumare in libidinem. Itaque semen etsi aëreum est, multo spiritu eoque calido confertum, calore tamen in spumam conuersum concrevit albescitque. Cuius etiam rei indicium est, quòd sub dio positum liquefit, cùmque iam planè refrixerit, spiritusque euauerit, nigrius id effectum dilapsumque diffunditur. Remanet enim velut aqua minimum quippiam habens terrenae portionis, quae dum exaruerit, manifestò deprehendi solet. Ex his autem quae euentuum obseruationibus confirmata sunt, palàm fit id quod propriè semen appellamus, natura calidum humidumque haberi. Iam verò seminis vires quanta sint verbis explicemus, idque ex Aristotelis decreto. Quoniam alimentum quod ad membra diffunditur et accedit, simile ei est quod tanquam superuacaneum relinquitur, semen aut manus, aut faciei, aut etiam totius corporis, manus est aut facies, aut corpus totum, sed promiscuè et confusè. Nam quale vnumquodque istorum reipsa iam est, tale et semen euadere potest, aut crassitudinis mole, aut facultate, quam in seipsum continet. Semen igitur (inquit) tale est, motumque habet et principium eiusmodi, vt motu peracto pars quaeque emergat, eademque sit animae viribus instructa. Omnia enim quaecunque aut natura aut arte fabricantur et ortum accipiunt, ab eo quod reuera iam est fiunt, ex materia quae habilitatem aliquam et adumbrationem habet futuri operis. Dehinc verò dum expressam atque solidam perfectionem consequuntur, in actum erumpunt, quemadmodum ex seminis materia in vterum emissa homo tandem procreatur, cuius species quaedam

through the power of cold, as hail or snow do, but through the inherent internal heat of the [P159] vessels and testicles. And it is not clotted by cooking, as are milk, an egg, or other things that have much admixture of earthy substance; in these a thicker portion remains when the moisture ["humor"] has been dispersed by the power of heat. No one is such an ignoramus as to reckon semen, a clearly airy or, rather, ethereal stuff, among these earthy things. So what is left? Water mixed with oil, or white of egg beaten for some time, bloats into a great swelling of dense white foam from air pent within it; in nearly the same way the semen within us is clotted and whitened by heat. For testicular heat stirs the vital spirit and the rest [of the spirits] as if in cookery ["concoctio"], and mixes the seminal material throughout; and since this material is very sticky, it readily swells into foam through the introduction of spirit, very close-knit foam too; but bubbles can barely be seen in it, anymore than in butter. This is clearly the reason for the ancient tale that Venus was born of foam, and in Greek Aphrodite is named from foam, as if to say, "Venus the foaming goddess," and "aphrodisiazein" is to "skim off the foam" ["despumare"] into lust. So even though semen is airy and full of much hot spirit, when converted into foam by heat it clots and whitens. The evidence of this is that when placed in the open air it liquefies, and when it has been utterly chilled and the spirit has vanished, it gets darker and flows away. What is left is like water with a tiny quantity of earthy portion, which can be clearly detected when it has dried up. From all this, confirmed by observations of what happens, it is obvious that what we properly call semen is hot and moist in nature.

Now let us explain in words how great the powers of semen are, from what Aristotle laid down. Since the nutriment that is distributed to the limbs and accrues to them resembles what is left behind as superfluous, the semen of the hand or face or even of the whole body is either hand, or face, or whole body, but indiscriminately and confusedly. For semen too can turn out to be like what each of these already is in reality, either by the bulk of its thickness or by a faculty that it holds within itself. So semen, he says, is such, and possesses a movement and origin of such a sort, that when the movement is over, each part makes its appearance, and is equipped with the powers of the soul. For all things that receive their fashioning and beginning from nature or from skill come into being from something that already really exists, out of material that possesses some readiness and preliminary outline ["adumbratio"] for the task ahead. While they are going on to pursue clear-cut solid perfection, they burst out into activity, in the way that a human being is finally begotten from the seminal material emitted into the womb, a human being whose form had come

et forma praecesserat in semine. Hoc quidem nullius corporis particulis conformatum conspicamus, quoniam tamen eae illinc aliquando comparebunt et exsuscitabuntur, viribus et facultate praeditum est, omnémque animae potestatem obtinet. Quum enim semen in animantis vtero conceptum non secus ac stirps vita fruatur et alatur, animam id in se continet naturalem et altricem. Ea quoque quae sensus particeps est à qua animalis nomen assumit, temporis progressu accedit, quum moueri incipit: tum demum rationis vis, cuius appulsu homo dici meretur. non [*sic*] enim simul animal fit et homo. Animam igitur naturalem in seminibus atque conceptibus nondum separatis haberi potestate statuendum est, non actu et reipsa: priusquam eo modo quo conceptus qui iam separantur, cibum trahant, et officio eius animae fungantur, principio enim haec omnia vitam stirpis viuere videntur. De anima quoque sensus particeps similis atque eadem est ratio. Duo haec principia, quoniam ad agendum indigent corporis adminiculo, sine corpore nequeunt consistere. Ex quo fit vt in semen extrinsecus ea non appellant: neque enim solitaria et per seipsa accedunt, quòd à corpore seiungi non possint, neque corpore quodam suffulta, quod diuersum sit à semine. Restat igitur vt semper in semine potestate fuerint, nunquam seiuncta. At verò mens illa simplex, nulla corporis terrena mole instructa vel indigens, sola extrinsecus accedit, eaque sola diuina est, nihil enim eius actioni cum corporis officio commune intercedit: omnis enim huius animae vis alterius corporis est particeps, quod magis diuinum est, quàm quae elementa appellantur. Quoniam verò protinus huius libri initio demonstrare proposuimus, omnium quae in nobis consistunt facultatum causas: iam ex his tanquam certa demonstratione confici potest, spiritus et eas quae in nobis vigent facultates, nec primam elementorum temperiem esse, nec ex ea, sed è semine solo originem habere. [Pr6o] Quanquam enim quatuor elementa optima temperie conuenient, et ad moderationem sese redigent, nequaquam tamen vllum animal vel stirpem efficient citra seminis, quod aut reipsa et actu, aut potestate duntaxat insideat, appulsum. Potestate dico ob stirpes, quae è terra sponte sua emergunt, et ob ea animalia quae ex putridae materiae vi proueniunt: in vtrisque enim non minima vis percipitur seminis, aut caloris qui eius potestatem habeat. Huius verò caloris vires et naturam

beforehand in the semen. We observe that this semen has not been shaped with the parts of any body; however, since these parts will sometime be roused from that source into making their appearance, the semen is endowed with powers and a faculty, and possesses the whole power of the soul. Since semen, once conceived in the womb of an animal, benefits from life and is nourished just like a plant, it holds within it a natural and nourishing [*“altricem”*] soul. The soul too that has a share of sensation, and from which an animal gets its name, accrues in the course of time, when movement starts; and finally, the power of reason, through whose influence a human being is entitled to be so called. For animal and human being are not produced simultaneously.

So we should determine that the natural soul is present in potentiality, but not in activity and reality, in semen and in fetuses not yet separated;⁴ this is before they draw out food in the way that fetuses do that have already been separated, and carry out the task of this soul, because at the start all these appear to live the life of a plant. The account is alike and the same too for the soul that partakes of sense. These two sources need the assistance of a body to act, and so cannot exist without one. This is why they do not move into semen from outside, and do not approach by themselves and on their own, because they cannot be separated from the body, and are not upheld by any body, because a body is different from semen. So the remaining possibility is that they have always been in semen in potentiality, and never separated. But it is reason pure and simple [*“mens illa simplex”*] alone, neither provided with nor in need of the earthy bulk of a body, that accrues from outside, and is the only divine soul, because nothing exists in common between its action and the body's task; the whole power of this soul is a sharer in the other body, which is more divine than the so-called elements. And since right at the start of this book we set out to show the causes of all the faculties that exist in us, what we have done can serve as a conclusive demonstration that the spirits and the faculties that thrive in us are not the original temperament of the elements, or have their beginning in that; their beginning is from the semen alone. [P160] Even though four elements should assemble in an ideal temperament, and bring themselves to moderateness, they will still fail entirely to make any animal or plant without the influence of semen, the semen being present either in reality and activity, or just in potentiality. I say “in potentiality” because of plants, which spring up from the ground on their own initiative, and because of those animals that issue from the power of rotting material. In each case more than a minimal [*“non minima”*] power of semen is perceived, or power of heat to possess semen's potentiality. Aristotle perpetuated the powers and nature of this heat in the

cap. 3.

Aristoteles³ memoriae propagauit, suprà quàm ad naturalem spectet. Dura (inquit) mollis, lenta, rigida, et quicunque alij affectus partibus insunt viuentibus, caloris et frigoris vi effici possunt. At ratio qua iam caro aut os est, non sic potest: sed à motu efficitur, proficiscente ab eo quod genuit, quódque energia tale est, quale potestate est id ex quo gignitur. Ex quibus clarum et euidentis est, quaecunque in viuentium numero habentur, sui ortum non primis rerum elementis, sed semini acceptum referre. Obiicies híc fortassis, id semen ex primis constare elementis, omnémque vim suam ex illis adeptum esse. Hoc certè non est vsquequaque verum, sed à diuiniore quodam magisque excelso principio robur assumit, quanquam est ex elementis concretum. Nam (inquit Aristoteles) omnis animae siue vis siue potestas, alterius cuiusdam corporis particeps esse apparet, eiúsque diuiniore quàm quae elementa appellantur. Verùm quemadmodum nobilitate obscuritatéque animae inter se discrepant, ita et natura eius corporis differt. Continet enim in se semen cuiusque, foecunditatis suae causam, nempe ipsum calorem, qui igneus minimè est, neque id generis facultatem aliquam aemulatur: sed spiritus qui in semine spumantéque corpore coeretur, et natura quae in eo est spiritu proportionem respondet elemento stellarum. Quamobrem ignis nullum animal generat, neque constitui quicquam densis, vel humidis, vel siccis videtur. At verò Solis calor et animalium, non modò qui in semine continetur, verumetiam si quid excrementi sit, quanquam diuersum à natura, tamen id quoque principium habet vitale. Caeterùm calorem in animalibus contentum, nec ignem esse, neque ab igne originem ducere, apertum ex his est. Hoc itaque Aristotelis decreto perfacilè liceat facultatum omnium et spirituum causas intelligere: quibus equidem in totum assentior et subscribo. Ab homine autem ad caetera quoque genita digressus, sciri velim omnium genitorum primam constitutionem ex elementis proficisci, omnémque materiam, omne temperamentum, et eas affectiones quas Aristoteles secundas qualitates appellauit, molle durum, rarum densum, crassum tenue, et similia, ab iis sumptas esse. At propria cuiusque ratio et essentia, qua idipsum est quod esse dicitur, nequaquam ex elementis emergit. Quemadmodum enim hominis essentia atque ratio, quae illius est anima, diuiniorem quàm qui ex elementis est ortum habet, sic et essentia ratióque carnis qua caro est, aut ossis qua os est, neutiquam ab elementis his densis atque concretis, sed ab elemento stellarum planè caelestem naturam sumit: et haec in caelesti quodam spiritu consistit,

record, above the record relating to natural [heat].⁵ A hard state, a soft state, a tough state, a stiff state, and any other that is present in living parts can be produced, he says, by the power of heat or cold. But the basis on which flesh or bone now exist cannot be produced in that way; this is done by a movement, setting out from what did the begetting; it resembles in actuality what it is produced from in potentiality. This makes it manifest that everything among living creatures derives its origin from the semen, and not from the primary elements of things.

You may object at this point that this semen consists of the primary elements, and acquired all its power from them. This is certainly not the whole truth: although it is composed from the elements, it takes its power from a more divine and lofty starting point ["principium"]. All the power or potentiality of the soul, says Aristotle, is found to have a share in some other body, a body more divine than the so-called elements. But souls vary in their celebrity or obscurity; similarly the nature of this body varies. Each man's semen holds within itself the cause of his fertility, that is, the actual heat, which is hardly fiery at all; this kind does not emulate some faculty; but the spirit pent up in the semen and the foaming body, and the nature in that spirit, match [singular; but adding only a tilde to the Latin would make it plural.] the element of the stars. Consequently fire begets no animal, and nothing is found to be produced by close-knit⁶ or moist or dry things. However, the heat of the Sun and of animals, not just what is held in the semen but also any waste there is (although waste differs from nature), possesses that vital principle too. But the heat held in animals is not fire, nor does it originate from fire; this is clear from what has been said ["ex his"]. And so, from what Aristotle laid down it may very easily be possible to understand the causes of all faculties and spirits; for my own part I wholly agree with them and endorse them.

Digressing from man to the rest of created things, I would like it known that the primary character of all created things proceeds from the elements, and all material, all temperament, and those dispositions that Aristotle called secondary qualities, soft and hard, loose-knit and close-knit, thick and thin, and the like, are acquired from them. However, the particular basis and essence of each thing, by which it actually is what it is said to be, does not come forth from the elements at all. For just as the essence and basis of a human being, which is his soul, has an origin more divine than one from the elements, so too the essence and basis of flesh by which it is flesh, or of bone by which it is bone, acquires its clearly heavenly nature from the element of the stars, not in any way from these dense solid elements. This nature resides in a heavenly spirit, and

hic autem spiritus est in semine, per quod genito toti impertitur. Ad eundem propè modum tum reliquorum omnium animantium, tum stirpium propria natura caelesti ortu profertur. Hinc facultates quasdam obtinent occultiores et reconditas, quas etiam caelestes appellant, nequaquam ex elementorum temperie profectas. Circumspectis rebus omnibus rationibúsque subductis, hanc de semine summam facio. Seminis materia vtilis atque syncera, eius alimenti quod partibus solidis attribuitur portio quaedam est, quae vi testiculorum attrahente, de singulis corporis partibus secreta decessit. Ex hac testes et vasa suo quo praedita sunt calore semen generant, quod tamen foecundum atque fertile neutiquam habetur, nisi plurimus spiritus vitalis ex toto confluat, qui diligenter ei permisceatur. Quod ea confusione gignitur semen foecundum, id substantia crassum est et spumans, colore album, pondere leue, natura aëreum, temperamento calidum et humidum. Eius substantia et crassitudo ex elementorum constat temperamento: praeter id autem calorem quendam diuinum atque caelestem obtinet, non ignis aut alterius elementi participem, in quo vita omnis consistit ac manet, in quo praeterea potestas insidet tum naturalis et altricis animae, tum eius quae sensum, motum, et appetitum habet. Hic dum efferuescit, quae compressae atque tacitae in eo delitescebant fa-[Pr6I] cultates, in actum erumpunt et viribus sese ostentant. Omnes has facultatum adumbrationes semen, non ab elementorum permistione, sed à parentis corpore consequutum est, in quo energia consistunt. Ex quo intelligi potest eum hominem qui emisso semine generat, omnes quoque corporeas facultates vnà producere. Caeterùm animum et eam animi partem quae princeps est, quaeque mens nominatur minimè is confert, quia cùm animus sit à corporis natura diuersus, eius substantiam non comitatur, sed extrinsecus in id illabitur ceu diuinum munus.

De foeminarum semine. Cap. VI.

FOEMINAS SEMEN proferre, hac potissimum ratione doceri potest, quòd testiculos et seminis vasa acceperint, crebris flexibus atque circuitibus intorta, haud secus ac in maribus enata. Quae omnia si natura non frustrà condidit, generandi seminis facultatem simul his attribuit, huiúsque causa fabricata sunt. Rei veritas sensus testimonio comprobatur. Nam foeminis quae diutius à coitu sibi temperarunt dissectis, in vasis semen circumfluere, idque iam albescere conspicitur,

that spirit is in the semen, by which it is conveyed to the whole created thing. In practically the same way, the particular nature, both of all the remaining animals and of the plants, is derived from a heavenly origin. From there they secure the more abstruse faculties, also named “heavenly,” which do not emanate from the temperament of elements at all.

Surveying the whole and trimming out the arguments, I make this summary about the semen. The useful and pure material of semen is a portion of the nutriment assigned to the solid parts, which has been separated and withdrawn from the individual parts of the body, through the attracting power of the testicles. Out of it the testicles and vessels generate semen through their endowment of heat, but the semen is in no way fertile unless a great deal of vital spirit gathers out of the whole, to be thoroughly mixed into it. The fertile semen generated by this mixture is in substance thick and foaming, in color white, in weight light, in nature airy, in temperament hot and moist. Its substance and thickness arise from a temperament of the elements, in addition to which it possesses a divine and heavenly heat, with no share in fire or another element, in which the whole of life has its dwelling, and in which too there resides the potentiality of the natural and nurturing soul, and of the soul that has sensation, movement, and appetite. While this [heat] is seething, the [P161] faculties that were lurking squeezed and silenced within it burst out into activity and display themselves by their powers. Semen has acquired all these outlines of faculties, not from the mixing of elements, but from the parent’s body, in which they exist in actuality [“energia”]. It follows that the man who begets by emitting semen brings forth also all the bodily faculties together. But he is not at all [“minime”] the contributor of the mind [“animus”] or of its main part, which is called the intellect [“mens”]; since the mind [“animus”] differs from the body’s nature, it does not travel with its substance, but glides into it from the outside, a divine gift.

Chapter 6. The female’s semen.

THAT WOMEN produce semen can be shown from this argument especially, that they have received testicles and seminal vessels, twisted in close bends, arising like those in the male. Unless nature instituted all these to no purpose, she provided women too with the faculty of generating semen, and these were made for that reason. The truth of the matter is proven by the evidence of the senses: when women who have refrained from sexual intercourse for some long time are dissected, semen overflows in the vessels, and is visibly growing white,

aequè ac in maribus: in ipsis verò testibus, crassius et perfectius. Quinetiam per insomnia eae interdum fatentur semen non minori se voluptate quàm in coitu eiaculari. Viduis et iis quae diutius veneris studia intermiserunt, vt per insomnia ita obscoenarum partium titillatione copiosissimum crassissimúmque semen erumpit. Quae cùm integra sensuum fides affirmet, non aliunde rationes petendae sunt, quibus doceatur semen in mulierum vasis haberi, idque concubitus magna voluptate profundi. Non idcirco mulieribus id concessum est, vt duntaxat impetum illis et quasi stimulum adderet ad venereos amplexus, sed ad alia quoque plurima conducit, quae paulò pòst afferemus. Id autem vim habere procreantem atque fingentem inde colligitur, quòd non alium in his quàm in maribus ortum et à testibus et à vasis acceperit, quòd etiam mulier quae morbo comitiali, calculo aut podagra affligitur, prolem gerit horum malorum haeredem: quòd demum partus sit plerunque matri similis: quae omnia non maternus sanguis, sed quod ab illa profusum est semen efficere potest. Ergo semen quod de mulieris partibus similaribus decessit, ad similibus partium effectiorem et conformationem vim quandam obtinet: tametsi ea profectò minor est et infirmior, quàm quae à maris semine confertur. Qualis autem et quanta sit ea vis, declarant oua quae subuentanea dicuntur, et rudiores molae quas mulieres quandoque proprij duntaxat seminis vi, nullo viri concubitu concipiunt. In his siquidem procreationis est quaedam adumbratio, et rudis materiae concretio, quam maris semen si suis instructum viribus accessisset, tanquam multo potentius numeris et ornamentis omnibus absoluisset. Neque tamen hoc per se et solitarium, sed foemineo duntaxat permistum quicquam perficit. In aduersam partem multis rationibus contendit Aristoteles, vt demonstret mulierem semen nec habere nec emittere. Eum certè humorem qui in mulierum vasis manifestò cernitur, et quibusdam in venereo complexu magna cum voluptate effunditur, satis quidem animaduertat: at is inquit seminis rationem non habet. loci enim proprius est, et vteri velut quaedam profusio, qualis etiam viris minimè foecundis sponte sua plerunque erumpit. Itaque cùm antè semen id esse definiuisset, ex quo primo oriuntur ea quae secundum naturam constituuntur, hunc istum humorem qui non sit ad generandum accommodatus, semen non appellauit. Eum humorem qui à foeminis cum voluptate emittitur, idcirco nihil ad conceptum conferre putat, quod plerunque (inquit) sine ea voluptate quae foeminis per coitum euenire solet, concipitur,

just as it does in men, and in the testicles themselves is thicker and more perfect. In addition, they sometimes acknowledge that they eject semen during dreams with no less delight than during intercourse. In widows and those who have given up erotic pursuits for some long time, very abundant and thick semen issues out both in the course of dreams and on stimulation of the private parts. Since the entire credibility of the senses confirms this, evidence does not need to be sought from elsewhere to demonstrate that there is semen in the vessels of women, and it is poured forth in the great delight of sexual intercourse. It is not granted to women for the purpose of adding just an urge and (as it were) spur to amorous embraces, but is of advantage in many other directions too, which we will bring in a little later. That it has a procreating and fashioning power is deduced in this way: it has received an origin no different in them than in men, both from the testicles and from the vessels; further, a woman afflicted with epilepsy, stone or gout bears offspring that inherit these ills; finally, the progeny usually resembles the mother. Maternal blood cannot produce these results, but the semen can do so that has poured from her. Therefore, semen that has been drawn from the similar parts of the mother possesses a power for the making and shaping of similar parts, although it is assuredly less and weaker than the contribution of the male's semen. What this power is like and how great it is, is shown by the so-called "wind-eggs,"⁷ and by the imperfectly formed moles that women sometimes conceive by the power of their own semen alone, without intercourse with a man. For in them there is some outline of procreation, and a condensation of crude material; if male semen, armed with its powers, had reached it, it would have brought it to completion in all its details and embellishments, being much more powerful. Yet male semen does not achieve anything by itself and on its own, but only when mingled with female semen. Aristotle maintains the opposite point of view by many arguments, to show that a woman neither possesses semen nor emits it. He had surely noticed well enough the humor that is clearly visible in the vessels of women, and in some of them is poured forth during sexual intercourse with great delight. But he says it does not possess the characteristic behavior ["ratio"] of semen. It is specific to its site ["loci proprius"], and like a sort of discharge from the womb, such as often issues spontaneously from virtually infertile men too. And so, having previously defined semen as "that from which things produced according to nature originate," he did not describe this present humor as semen, since it is not suited for generation. He believes that the humor emitted by women with delight contributes nothing to the fetus ["conceptus"], for the reason that conception often occurs without the delight that women usually experience

si locus turget, et vterus propius descendit. Non desunt qui eodem interpretationis genere, hunc mulieris humorem semen appellent, sed quod foecundum non sit. Rationes autem quae illis foecunditatis vim adimunt hae sunt. In omni rerum procreatione aliquid est vt efficiens, aliquid vt materia: quae quanuis in fruticibus vnum idémque esse videantur, forma tamen et rationis dignitate longè latèque distant. In perfectioribus autem animantibus, vt hae facultates sexibus distinctae apparent, ita efficientis et patientis tum naturae, tum corpora diuersa sunt. Quocirca cùm sit mas effi-[P162] ciens, foemina verò patiens: haec ad procreationem, non verum semen, sed materiam duntaxat conferet. In quibus enim mas à foemina separatur, natura generandi principia non miscuit, sed prorsum vt viribus ita et sedibus ea disiunxit. Si foemina semen gerit foecundum, cùm alterum principium nempe materiam contineat, poterit citra maris congressum, ex seipsa foetum edere. Hoc si fieri potest, frustrà mas erit. Absona autem haec sunt, foecundum igitur non est mulieris semen, nec quicquam constituere potest. Oua subuentanea quae gallinae citra maris opem pariunt, imperfecta sunt et infoecunda. In piscium genere cùm foemina ova deposuerit, mas deinde illa semine conspergit: quaecunque id attigerit vitam assumunt, reliqua autem irrita, et à maris calore destituta contabescunt. Ex quibus perspicuum esse volunt, foeminae si quod semen inest, id vim nullam habere efficientem et procreatricem, sed tanquam materiam maris semini subiici: quae tamen ardoris stimulo foeminam ad coitum impellit, simúlque vterum ad concipiendum parat et accommodat. Maris autem semen, tum materiam, tum vim et facultatem eximiam habens, procreationis efficiens est et opifex. Quapropter mas formam motúsque principium, foemina verò corpus atque materiam affert. Haec rursum valida istiusmodi ratione stabilire contendunt. In perfectiorum animantium genere foemina quem conceperit foetum diu gestat atque alit: hoc autem efficere non potest, nisi superuacaneorum redundantiam frigido humidóque suo temperamento congerat: eiusmodi ergo cùm sit foemina, neque copiosum, neque crassum, neque calidum, idcirco neque foecundum semen potest efficere. Hoc cùm Aristoteles animaduertisset diligentius, mox subiunxit: si semen esset, menstrua non essent, idcirco autem illud deest, quoniam haec insunt. Itaque foemineum semen non eam elaborationem, non eos vitales spiritus,

through intercourse, if the site swells and the womb comes down nearer. Many people, following the same kind of interpretation, call this female humor semen, but semen without fertility. The reasons that for them remove the power of fertility are the following: in every procreation of things there is something that is active ["efficiens"], and something that is the material. Although these [two] appear to be one and the same in [the case of] bushes, they are in form and in the significance of their behavior very far apart indeed. But in the more perfect animals, these faculties are seen to differ between the sexes, and both the natures and the bodies of the active and passive [partners] diverge. Consequently, since the male is [P162] active, the female is passive; for procreation she will contribute not true semen, but just material. In cases where the male is distinct from the female, nature has not mingled the guiding principles of generation, but has completely separated them, both in their powers and in their locations. If a woman bears fertile semen, since she embraces the other guiding principle, that is, the material, she will be able to give rise to a fetus from herself, without intercourse with a male. If this can occur, the male will have no purpose. There is discordance here; so the female semen is not fertile, nor can it produce anything. The wind-eggs that hens bring forth without male cooperation are imperfect and infertile. Among the kind ["genus"] of fishes, when the female has deposited eggs, the male then sprinkles them with semen; all that the semen has reached take on life, but the rest are infertile, and without the heat of the male they rot. From this, people wish it to be clear that if there is any semen in a female, it has no active procreating power, but as material is subject to the male's semen, material however that through the spur of its warmth urges the woman on to intercourse, and at the same time readies the womb for conceiving. The male semen, owning excellent material, power and faculty, is effective in procreation and is the craftsman. Hence the male supplies the form and the principle of movement, while the female supplies the body and the material. They try in addition to found these points on a strong argument of this sort. Among the kind ["genus"] of the more perfect animals, the woman carries and nourishes the fetus she has conceived for a long time. But she cannot do this unless she collects the excess of superfluous matter with her cold and wet temperament. So, since the woman is like this, she cannot make semen that is abundant, thick, hot, and consequently fertile. When Aristotle had carefully observed this, he went on to add: if semen were present, there would be no menstrual flow; so the former is absent because the latter is present. And so, although female semen has received a similar method of coming into being, it cannot possess the painstaking effort, the vital spirits, or

non eas denique vires quas masculum potest obtinere, quanquam similem ortus sui modum accepit. Hinc conficiendum putant, id non debere seminis appellationem sortiri, aut si semen dicendum videbitur, quia non foecundum id est, et modicùm à menstrui sanguinis natura discessit, homonymiam committi. At verò si altius omnia scrutabimur, solui quidem haec poterunt. Etsi enim rationibus inniti videntur, quae ex philosophiae theorematibus depromptae sunt, hoc tamen duntaxat efficiunt, maris semen praestantius atque foecundius esse quàm foeminae: non autem illud solùm vim habere efficientem, hócque prorsus infoecundum tanquam materiam subiici. Commentitium enim videtur, et anicularum figmentis proximum, solum maris semen ex materno sanguine citra ullam foeminae opem, perfectum quicquam progignere, nec est profectò earum muliercularum dictis fides habenda, quae asseueranter pronuntiant se nulla coitus voluptate vtero concepisse. Vt autem quae à gallinis eduntur oua subuentanea, sic et quae galli pariunt exigua, compertum habemus nequaquam foecunda esse. Necessum est igitur amborum semina mutua substantiae familiaritate et amicitia se copulent et prorsus confundantur, si qua inde futura est absoluta procreatio. Semen non idcirco foecundum appellamus, quòd solùm ex sanguine quippiam generet, ita enim ne masculum quidem foecundum haberetur: sed hinc quòd dum alteri confunditur ad generandum conferat. Nunc autem quis demonstrare possit, foemineum non opitulari masculo? Si nobis permittetur Aristotelis rationem huc accommodare, ea certè quanuis ab aduersario petita, rem nostram omnem constituet, et quasi sepimento aliquo vallabit. Is enim naturam ait maris ac foeminae vtrunque sexum in fruticibus miscuisse, quod sola vis mascula (licet terra materiam ei conferat) non satis sit quae procreationem in stirpibus efficiat. Quòd si in his, multo magis opinor in animantibus, quae praestantiori sunt ordine, necessum fuerit maris ac foeminae vires coniungi, non idcirco duntaxat vt foemina materiam suppeditet, sed vt copulatis atque confusis amborum viribus, semen vnum ex ambobus procreationi aptum proferatur. Hoc igitur integris absolutisque viribus praeditum, tanquam opifex in subiectam materiam incumbit. Haec de semine procreationis humanae principio, nunc de materno sanguine disserendum.

[P163] *De menstruo sanguine. Cap. VII.*

MENSTRUUM NON quemadmodum semen vltimi alimenti, sed sanguinei portionem quandam esse, hoc est indicium, quòd non mariscae, non fluxus sanguinis è naribus, non varices, non tale quicquam

the powers of male semen. They think this should show that it ought not to be allotted the name of semen; or, if it seems in order to call it semen, a homonymy is perpetrated, because it is not fertile, and has departed somewhat from the nature of menstrual blood. However, if we go more deeply into everything, these questions will be capable of resolution. For even if they seem to rely on arguments fetched out from the problems of philosophy, yet they only prove that the male's semen is more excellent and fertile than the female's, not that the male's alone has the efficient power, and the female's is entirely infertile and is supplied as material. It seems fanciful, and very like old wives' tales, that the male's semen alone begets something complete out of the maternal blood without any assistance from the woman; nor can any reliance at all be placed in what little ladies say who insist that they conceived in their womb without any pleasure from intercourse. Like the wind-eggs produced by hens, the little things that cocks bring forth are, we have found, not fertile at all. So the semen of both must unite and be thoroughly mingled in the mutual intimacy of their substance, if there is to be any perfect procreation. We do not call semen fertile because on its own it can beget something from blood, for then not even the male would be reckoned fertile, but because while it is mingling with the other, it contributes to generation. Who now could show that the female does not give assistance to the male? If we may adapt the reasoning of Aristotle here, even though it was our opponent who introduced it, it will make our whole case, and fortify it as though with a palisade. He states that the nature of male and female has mingled both sexes in the case of bushes, because the male power alone (though the earth provides material for it) is insufficient to bring about procreation in plants. But if in them (and I think much more so in animals, which are of a loftier status) the powers of male and female have had to be combined, the reason is not just to let the female supply the material, but so that with the union and mingling of the powers of both, one semen is produced from both fit for procreation. So it is endowed with complete and perfect powers, and devotes itself like a craftsman to the material supplied ["subiectam"]. Enough about semen, the guiding principle of human procreation; now we are to discuss maternal blood.

Chapter 7. The menstrual blood.

[P163] THE MENSTRUAL flow is not a portion of the final nutriment, as semen is, but a portion of the [another] nutriment that consists of blood; the evidence is that piles, nosebleeds, varicose veins, and anything of the sort do not for the

mulieribus magna ex parte accidere solet, quandiu id profluit: si quid horum erumpit, deterior fit menstrua purgatio, quod huius materia aliò rapta dissipetur. Eorum animantium quae viuum foetum edunt, foeminas menstruo abundare necessum est, vt hoc foetum quem stato tempore vtero gerunt plenè alant ac sustentent. Quò autem hanc alimenti vbertatem natura suppeditaret, foeminam imbecilliolem frigidiorémque mare constituit. Hic quidem quia plurimo calore circumfluit, omne quod suscepit alimentum perfectè mitigat atque coquit: et si quid praeterea redundat, id potenter discutit. At foemina quae haud ita multum à mare perfectè calido disiuncta est, alimentum satis quidem conficit, infirmiolem tamen calorem obtinuit, quàm vt quod redundat possit discutere. Proinde illi ex frigida imperfectaque natura, menstrui sanguinis vtilitas accessit. Quaecunque animantia ouum pariunt, nec foetum in se viuum continent, mensibus non purgantur: minus enim sanguinis obtinent, aues quidem quia sicciore, pisces quia humore plurimo circumfluunt. Haec vna ratio efficit, vt in reliquorum animantium genere mulier plurimum menstrui sanguinis emittat. Calida enim et humida est illius constitutio, carétque pilis, cornibus, vngulis, aliisque particulis, in quas solet caeteris animantibus superuacua moles conuerti. Quaecunque porrò plenius gulae ventríque indulgent, et vitam inertem otiosámque traducunt, quoniam exercitationis defectu et caloris inopia minimum superuacui sanguinis discutitur, eius plurimum coaceruant. Vnus ergo sanguis redundans, tum viris materia prima fit seminis, tum mulieris menstrui. Vt enim maribus, sic etiam foeminis circa annos pubertatis ingens incidit corporis vniuersi mutatio: ac tum temporis incremente iam et vegetiore facto natiuo calore, pubes erumpit, vbera tumescunt, corpus libidine titillatur, exuberans sanguis calore veluti extenuatus diffunditur, víxque suis receptaculis coërcitus, viam sibi parat qua dimanet. Quamobrem hac aetate prodidit Hippocrates maribus sanguinis è naribus profusiones, puellis verò menstruorum eruptiones obtingere. Illis siquidem venae quae ad nares constitutae sunt, his verò quae in vterum ínque eius ceruicem inseruntur, faciliùs promptiùsque reserantur et patefiunt. Itaque qui in vena caua redundat sanguis, in vteri venas perlabitur, hásque copia et calore distendens aperit, vt ab earum osculis stillans dimanet, profluátque è partibus obscoenis. Imminuta copia circumcisáque redundantia, quod reliquum est et corpori necessarium venae retinent: dum verò menstrui nihil amplius erumpet, quae ad vterum pertinent ora venarum, sponte sua occludentur et conniuebunt. Mensis vnus curriculo tantum denuò congeritur et accrescit,

most part happen to women as long as the menstrual flow lasts. If any of these does break out, the menstrual clearing deteriorates, because its material is being snatched away elsewhere and dispersed. Of the animals that bring forth a living fetus, the females must brim over with menstrual flow, with which to nourish fully and support this fetus they carry in the womb for the appointed time. To enable nature to supply this wealth of nutriment, it makes the female weaker and colder than the male.⁸ Since he overflows with a great deal of heat, he completely modifies and digests all the food he has taken in, and he powerfully dispels anything further overflowing. But the female, who is not so far different from the male with his ideal heat, does deal adequately with food, but secured a heat too weak to be capable of dispelling an excess. She has accordingly been granted the benefit of menstrual blood, out of a cold and imperfect nature. The animals that produce an egg and do not enclose a living fetus within themselves are not purified by menstruation; they possess less blood, birds because they are drier, fish because they are surrounded by a great deal of moisture. This single reason brings it about that among the kind ["genus"] of the remaining animals, the female emits much menstrual blood. Her constitution is warm and moist, and lacks hairs, horns, hooves, and the other parts into which [a] superfluous mass is converted in the rest of the animals. In addition, those that overindulge their appetite [for food: "gula et venter"] and spend their lives in idleness store up very much of this mass, since very little of the excess blood is dispelled because of inactivity and lack of heat. The same excess blood becomes the primary material for semen in males, and in females for menstrual blood. There occurs a massive change in the whole body, in females just as in males, around the years of puberty, a time at which, with the innate heat now rising and gaining in vigor, the pubic hair sprouts, the breasts swell, the body is stimulated by desire, the blood surges up and spreads out as if it were thinned by heat; barely held in by its receptacles, it makes itself a way to run out. So Hippocrates recorded that at this time of life nose bleeds befall the males, and outbursts of menstruation befall the girls. For in the males the veins situated at the nostrils, and in the females those embedded in the womb and its neck, come open more quickly and easily. And so the excess blood in the vena cava glides into the uterine veins, which it distends by its abundance and heat and breaks open, so that it drips out from their orifices, and runs out of the private parts. With the reduction of the supply and the curbing of the excess, the veins hold back the remainder and what the body needs. When no more of the menstrual flow is escaping, the venous apertures related to the womb will close up of themselves. After a lapse of one month only, as much as had flowed out previously is

quantum antè profluxerat, idque simili prorsus ratione, naturae impulsu per vterum deponitur. Non est autem quòd aliquispiam existimet, hanc duntaxat sanguinis redundantiam circuitus causam esse, quoniam iis etiam quae sanguinis exiguum congesserunt, quanquam parcius, statis tamen circuitibus profunditur. At huius circuitus causa, aut in naturae consuetudinem, quae omnia certis legibus, statisque periodis exequitur, aut in sempiternos et immutabiles lunae cursus referenda est: quae vt luminum varietate, tum crescens, tum senescens, mensem dimittitur, sic hominis vt sanè reliquorum omnium humores, rata ordinis constantia regit, atque moderatur. Ne quis porrò menstruum sanguinem existimet quasi affluentiam et exuperantiam esse sanguinis vtilioris, et ei prorsum similem qui in venis pro alimento est, velim equidem hoc loco plenior de illo rationem institui. Plurimum in mulieribus fieri auctor est Aristoteles, et eum qui statis circuitibus profluit, genus esse quoddam sanguinis vitiatum, et quasi aegrotans. Etenim à puriore sanguine secernitur naturae beneficio, praesertim decrescente aut silente Luna. Hoc excidente, si nouella vitis tangatur, in perpetuum laeditur, steriles fiunt tactae fruges, moriuntur insita, exuruntur hortorum germina. Si omnino mulier praegnans alterius menstrua supergrediatur, aut illis circumlinatur, abortum facit, ei autem quae vterum non gestat, concipiendi spem [Pr64] adimit. Mulierum quae purgantur spiritus et vapor ab ore, specula atque eboris nitorem obscurat [singular, as in 1542]. Gustatus hic sanguis canes in rabiem agit, homines autem miris cruciatibus affligit, comitiale morbum, pilorum effluuium, aliáque elephantorum vitia idcirco a veteribus inter venena relatus, pari malignitate existimatur atque sanguis elephantici potus. Hinc dum in muliere supprimitur, nec statis temporibus emanat, ei etiam cui proprius est, debétque familiaris esse, grauissima affert incommoda: viscerum obstructions, tabem, cancrum, morbum comitiale, huiusque perniciiei quamplurima. Quum itaque tanta sit eius perniciies, sitque vis ei tam pestifera, vix animum induco fieri posse, vt ex eo foetus in vtero gestatus alimentum capessat: imò tum optimè solet mulier vtero concipere, quum ab hac foeda eluue munda repurgatáque fuerit, quúmque purus existet tum vterus tum reliquus sanguis in corpore, ex quo demum foetus aletur. Quanquam autem reliquo deinceps temporis circuitu, vitiosus similiter ac prius congeritur et accrescit, eo tamen haudquaquam foetus continetur aut viuít, nec eum, sed quantum potest purissimum, atque suauissimum pro alimento rapit sibique iungit. Quónam igitur corruptus

accumulated again, and is shed on just the same basis, at nature's prompting. It may be thought that the cause of the cycle ["circuitus"] is just the excess of blood; but this is not the case, for even in those who have amassed little, it streams forth at the appointed intervals, though more sparingly. No, the reason for this cycle is to be attributed either to the practice of nature, which carries everything out by fixed rules and appointed periods, or to the eternal immutable phases of the moon. As the moon measures out the month by its changing lights, now waxing and now waning, so does it control the humors of man (presumably like those of everything else) on an established permanent sequence. Furthermore, to prevent anyone thinking of menstrual blood as an access and surplus of more useful blood, and as just like the blood serving for nutriment in the veins, I would like for my own part to have a fuller account made here of it. Aristotle is our authority that very much of it is made in women, and that what flows out at the appointed cycles is a damaged and (so to speak) sick kind of blood. It is separated from the purer blood, thanks to nature, especially with the Moon waning or in abeyance ["silens"]. While it is running out, if a young vine is touched [presumably by the menstruating woman], it is harmed for good, fruit that has been touched is infertile, grafts perish, the gardens' buds dry up. If a pregnant woman treads at all on the menstrual flow of another woman, or is soiled by it, this causes abortion, and it [PI64] deprives a nonpregnant woman of the prospect of conceiving. The breath ["spiritus"] and steam from the mouth of menstruating women dulls mirrors and the sheen of ivory. If tasted, this blood drives dogs into rabies, and torments human beings with extraordinary sufferings: epilepsy, loss of hair, and other disorders of elephants.⁹ On this account the ancients included it among the poisons, and thought it as harmful when drunk as elephant blood. Hence, when it is suppressed in a woman and does not flow out at the appointed times, it brings extreme harm to her to whom it properly belongs and should be welcome: blockages of viscera, wasting, cancer, epilepsy, and very many [sorts] of this destruction. And so, since it wreaks such destruction and has such noxious power, I can hardly persuade myself that a fetus carried in the womb possibly snatches nutriment from it; further, a woman usually conceives best when she has been cleansed and cleared of that foul rubbish, and when both the womb and the remaining blood in the body prove to be pure, to be the source later of fetal nourishment. Although during the rest of the temporal cycle from then on, faulty blood accumulates as before, the fetus does not secure its maintenance or life from it, and does not seize and incorporate it for nutriment, but the purest possible and most pleasant blood. To where then does this corrupt

ille sanguis, quem menstruum appellauimus in grauidis concedit? Pars exigua circa vterum inhaeret in venis, pars maxima reliquo puriori sanguini permiscetur. Hinc quia nequit naturae vis omne illius virus mitigare aut euincere, grauidis mulieribus plurima mala obueniunt, corporis grauitas, foedus faciei color, lienis tumores, varices, malacia: atque vt in genere dicam, ab hoc retento in omne morbi genus praecluiiores [*sic*] sunt, quàm quae vterum non gestant. Hunc autem natura intus continet, ne si viam patefaceret, cum eo vtile foetus alimentum simul emanaret. Itaque natura nouae prolis procreationem instituens, in vitae discrimen plerunque parentem adducit. Non igitur menstruo foetus alitur, si hac appellatione corruptum cum sanguinem notamus, qui purgatio est et excrementum purioris. At verò quoniam hoc nomine omnem sanguinis ab vtero factam deiectionem saepius veteres significarunt, ferè fit vt foetum ali et lac gigni ex menstruo sanguine pronuntiemus. De semine ac sanguine menstruo, quid sint, vnde et ex qua materia, et quomodo gignantur, dictum iam satis est: nunc verò de hominis procreatione tradendum.

De seminis conceptione, et prima hominis constitutione. Cap. VIII.

QUONIAM IN animantium genere conducebat marem et foeminam separari, solers et prouida rerum natura, vt eos quandoque ad generis propagationem inuitaret, et ne vniuersum genus intercideret, libidinem quasi stimulum ex seminis ardore vtrique iniecit: et partibus obscoenis illecebras et admirabile congressus desiderium, vt sua semina in vnum conferrent, alioqui prorsus inutilia futura. Quare praeter testiculos quorum est semen generare, conditae sunt partes obscoenae, iisque insigniores duo nerui eximij sensus inserti, qui viris desinunt in glandem, venereae voluptatis sedem. Dum itaque qui concauus est in pene neruus, spiritus copia impletur, penem arrigit, viasque distendit, per quas semen directè et impetu iaculemur. Veneris autem ingens facta delectatio, seminis vasa et testiculos irritat. Hinc mirificè impulsum semen turgidumque spiritus vbertate, vix potest suis vasis contineri, sed cogitur foras exilire ingenti voluptate, viris quidem quodam quasi saltu ob viae flexum et longitudinem, mulieribus verò languidius. Vt autem omnes hae causae maiores sunt in viris quàm in

and so-called menstrual blood withdraw in pregnant women? A tiny part clings in the veins around the womb; the majority is mingled with the remaining purer blood. Consequently, nature's power being unable to modify or conquer its whole poison, numerous ills befall pregnant women: bodily heaviness, a repulsive facial color, splenic tumors, varicose veins, pica.¹⁰ And to put the matter generally: the retention of this blood makes them more liable to every kind of disease than are those who are not pregnant. Nature keeps it inside, in case useful nutriment for the fetus should percolate out with it at the same time, if this blood were to open the way. Thus, in starting the procreation of a new offspring, nature usually puts the parent at risk of her life. So the fetus is not nourished by the menstrual flow (if we use this term for that unsound blood), which is the dross and refuse of the purer blood. However, as the ancients often used this name for every evacuation of blood from the womb, we commonly come to say the fetus is nourished and milk is generated from menstrual blood. Enough has now been said about semen and menstrual blood, what they are, the source and identity of their material, and how they are produced; now we must discuss the procreation of the human being.

Chapter 8. The conception of the semen, and the original establishing of the human being.

BECAUSE IT was appropriate in the kind ["genus"] of animals for male and female to be separate, in order to invite them to the propagation of their kind, and to prevent the loss of the whole kind the wise and provident nature of things implanted lust in both as a sort of goad, derived from the warmth of the semen, and attractions in the private parts and a remarkable desire for sexual intercourse, so that they would combine their semens into one; otherwise these would be of no use. This is why, apart from the testicles that have the task of generating semen, the private parts are concealed, and in them two quite notable nerves of exquisite sensibility are implanted, which in men terminate in the glans penis, the seat of erotic pleasure. And so, while the hollow nerve in the penis is filled with abundance of spirit, it erects the penis and opens up the paths by which we ejaculate semen straight out and with vigor. When sexual enjoyment grows very great, it rouses the seminal vessels and testicles. Hence the semen, wonderfully propelled and swollen with the richness of spirit, can hardly be contained in its vessels, but is constrained to spring outside with great delight: in men with a sort of leap, the path being long and twisted, but in a more leisurely fashion in women. All these causes in men surpassing those in

mulieribus, sic illos constat in coitu maiore voluptate teneri quàm mulieres: quanuis hae pluribus modis oblectantur, nempe dum semen erumpit, atque etiam dum vterus viri semen auidè suscipit et amplectitur. Hinc Tiresias vates, qui vtrumque sexum fingitur expertus, mulierum partes visus est tutari. Porro autem seminis emissio non fit in vteri sinum, quoniam eius os internum conuiuere occludique solet, sed in ceruicis fundum excidit ad os vteri, quò plerique seminis vasa et testiculos deriuari prodiderunt. Illuc igitur viri et mulieris semina confluunt: hincque (vt author est Aristoteles) in vterum angusto ore rapiuntur. Profusio (inquit) seminis non intrò fit, vt quidam vo-[P165] lunt, os enim vteri angustum est, sed antè, quo foemina mittit vaporem illum nonnullarum recrementum: eodem enim mas etiam mittit quod fuderit, et aut ibidem manet semen emissum, aut intrò ab vtero trahitur, si calidus est et modicè temperatus. Cuius rei indicium, quòd locus qui modò madebat, resiccatus mox sentiatur. Sic et Oribasius,⁴ Duo (inquit) orificia habet vterus, vnum interius, alterum externum, in quod viri genitale semen conditur, in illud quidem non ingreditur, sed trahit vterus ad se semen, quemadmodum cucurbitula. Idipsum videtur alio loco planius expressisse. Quemadmodum è profundis cuniculis ceruus serpentem narium inspiratu allicit,⁵ sic vterus viri semen è sua ceruice. Miror ab his atque etiam à vero Galenum descuisse, qui putauit mulierem semen per cornua in solum vteri sinum eiaculari. Quum illa vterum gerens fortasse concumbet, quónam tandem semen id vteri sinu susceptum euadet? Obsignatum enim tum adeò est os vteri interius, vt nihil vel minimum subire possit aut excidere. Hoc si in praescriptum pariendi tempus intus contineretur, inutile prorsus et otiosum computresceret, et grauissima tum animi, tum corporis incommoda necessariò inueheret. Hac forsitan ratione perterritus Auicennas, inconsideratè statuit grauidam mulierem, nullis virium conatibus, posse in concubitu semen effundere. Ad hunc itaque modum semen prolecat vterus, si quidem validus est et inanis, appeténsque veneris: atque si futura est conceptio, mulier quadam voluptate praesentit vterum gestire: miróque seminis desiderio totum in partes obscoenas prouolui, vt ei obuius ore quasi manu id excipiat, aut potius arripiat. Acceptum deinde continet auidissimè

Apho. 23
lib. 6.

women, it is accepted that men are possessed by more pleasure in intercourse than women are; although women do get delighted in very many ways, when semen issues out, of course, and also while the womb eagerly takes up and enwraps the man's semen. Hence Tiresias the seer, who is supposed to have had experience of both sexes, seemed to take the side of women.¹¹ Again, the ejection of semen is not made into the uterine cavity, since its internal mouth is normally closed, but into the bottom of the cervix near the uterine mouth; most people have held that the seminal vessels and the testicles are connected to that point. So it is where (on Aristotle's authority) the male and female semen converge, and are snatched into the womb by its narrow mouth. The outpouring of semen, he says, does not occur inwards, as some would have it, because the [P165] uterine mouth is narrow; it occurs in front, the direction in which the woman sends the vapor that is a waste matter of some of them [women, evidently]; the man sends what he has poured forth too in the same direction, and the ejected semen either stays in the same place or is drawn inwards by the womb, if it is hot semen and moderately tempered. The evidence for this is that the place that was moist a moment ago can soon be found dry again. Oribasius's account runs thus: "The womb has two mouths, one is inside, the other outside, the one in which the male's genital semen is stored; this does not make its way into the inside one, but the womb draws the semen towards itself, as a cupping-glass does." It seems that he put the same point more clearly elsewhere. A stag sucks a snake out of deep burrows by nasal inhalation: in the same way the womb sucks the male semen out of its own cervix.¹² I am surprised that Galen abandoned this account and the truth; he thought that a woman ejects semen along the [uterine] horns into the uterine cavity only. When she happens to have intercourse while pregnant, where will that semen held up in the uterine cavity get out in the end? At that time the internal mouth of the womb is so tightly sealed up that not even the tiniest thing can get in or out. If it were to be retained inside until the appointed time for giving birth, it would rot in complete uselessness, and be bound to introduce very serious troubles of both mind ["animus"] and body. Possibly frightened by this reasoning, Avicenna rashly declared that a pregnant woman could emit semen during intercourse without any efforts of her powers. And so the womb entices semen in this fashion, provided it is strong and empty, and eager for love; and if there is to be conception, the woman has a pleasurable presentiment that her womb is impatient; and, with a marvelous longing for the semen, it is pushed out into the private parts, so that it faces the semen and receives it, or rather, seizes it, with its mouth as if with a hand. Then it holds on very greedily to what it has

ac in sinus suos recondit, adeò certè id vndique comprehendens, vt nullum intus spatium inane sinat: quin et in id sese contrahens, os suum adeò coarctat et claudit, ve ne vel minimum quidem dehiscat: ceruicis autem os quod est ad partes obscoenas, nunquam non patet. Sic quidem Hippocrates memoriae prodidit, iis quae vtero gerunt vteri os comprimi, hócque testimonio, si obstetrices immisso digito, os vteri conniuere sentiant, mulierem concepisse pronuntiat [present tense; 1542 has “denuntiauit”]. Caeterum si imbecillior erit vterus, quod in vitiosis affectibus fit, aut si minus appetens erit seminis, vt in grauidis et in iis quarum libidinis ardor euauit, quaeque expletæ iam sunt venere: viri semen in ceruice aliquantum considens, mox foras excidit et elabitur. Id autem mulier foecunda facilè apprehendet et retinebit, si integra sit valetudine, si paucò antè tempore repurgata et munda sit à mensibus, si pariter cum viro aut paulò pòst id ei aculetur. Ita enim si eodem impetu atque vir semen emittit, aut si paulò antè cùm iam libidinis furor plurimum incensus est, vterus ingenti voluptate et auiditate id allicit et in se recondit. Contrà verò si multò pòst aut antè quàm mulier, vir semen emittat, cùm nempe vel nondum efferuescit, vel iam cessauit impetus libidinis in muliere, vterus aut semen non prolecat, aut certè non continet: neque si continet, vtile id redditur, propterea quòd nimia mora à foemineo destitutum est, spiritúsque totus euanescit. Neque profectò seminis attractio neque retentio, conceptio est, tametsi id ratio nominis videtur indicare. Non rarò enim auidus vterus semen attraxit, quod diu continere non potuit, sed biduo aut triduo siuit elabi. Est et cùm id diutius inutiliter reseruat, vt in mola, quae nec conceptio vera est, huius enim mole opprimitur et laborat, perinde vt ventriculus cibo graui et immutabili, quem tamen traxit ac continet. Est igitur conceptio propria et peculiaris vteri actio, qua seminis potestas exuscitur, et insitum sibi munus reipsa obit et exequitur. Quemadmodum enim terra ferax et foecunda, exceptum semen suo calore fouet, deinde excitat et ad parturiendum impellit: sic vterus foecundus ingenua vi, quae alteri nulli parti est concessa, sopitam seminis vim et delitescentem in eo potestatem excitat, et ad agendum extimulat, vt energia fiat et dicatur. Tum temporis semen opus aggreditur et suscipit, quod antè nusquam agere potuisset: alioqui enim mas solus in seipso generaret. Itaque seminis potestas in actum erumpit et exuscitur

received, and stores it in its recesses, grasping it so securely all around that no empty space is left inside; and furthermore, contracting upon it, it tightens and closes its mouth so much that there is no gap, or only the smallest one; but the mouth of the cervix, which is at the private parts, is always open. Thus Hippocrates handed it down to tradition, that in pregnancy the uterine mouth is kept closed, and on this evidence, if the midwives insert a finger and feel that the uterine mouth is shut, he announces that the woman has conceived. However, if the womb is less strong, as occurs in diseased states, or is less eager for semen, as in pregnancy and in women whose erotic ardor has vanished and who have now reached the end of love, the male semen settles for a little in the cervix, and soon drops out and slips away. A fertile mother, on the other hand, will readily seize and retain it, if she is in sound health, has menstruated recently and is cleansed of her menstrual flow, and emits it [i.e., her own semen] at the same time as the man, or soon after. If in this way she emits semen with the same impulse as the man, or a little earlier when the frenzy of desire is already greatly kindled, the womb entices the semen with huge satisfaction and eagerness, and stores it within itself. But on the other hand, if the man emits semen long after or before the woman, when of course the impulse of desire in the woman has either not yet boiled up or is already over, the womb either fails to attract the semen, or anyway does not retain it; and even if it does retain it, it is not made effective, the reason being that through excessive delay it is abandoned by the female semen, and all its spirit vanishes. But assuredly conception is not the drawing in nor the retaining of the semen, even if the meaning of the word seems to indicate this. For quite often an eager womb has drawn in semen, which it could not retain for long, but allowed to slip out within two or three days. And there are times when it stores it longer to no purpose, as in the case of a mole, which is no genuine conception, because the womb is smothered by its bulk, just as the stomach is by heavy indigestible food, which it has nevertheless drawn in and is retaining. Conception is, therefore, a special and particular action of the womb, by which the potentiality of the semen is aroused, and it discharges its inherent function in fact. Fertile land nurtures with its warmth the seed it has received, then rouses it and propels it towards bearing fruit; in the same way, by an innate power granted to no other part, the fertile womb rouses the slumbering power of the semen and the potentiality lurking in it, and urges it into action, so that it may become and be regarded as actuality ["*energia*"]. This is the time when the semen sets about and takes on a task that it could not have done under any circumstances before; for otherwise a male could beget alone within himself. And so the power of semen is stimulated

vteri vi: atque ea ipsa exuscitatio conceptio est. Auicennas et qui eius institutionem sequuntur, perperam censuerunt seminis potestatem in actum erumpere ea corporis exagitatione, quae fit in concubitu. Primùm itaque vterus semen attrahit, attractum continet, contentum concipit: haud [P166] secus atque ventriculus tractum contentumque alimentum conficit, vt enim concoctio ventriculi, sic conceptio vteri propria est actio. Ex his profectò quiuis perspicere possit, quae ad probam et exquisitam conceptionem desiderentur. In primis enim necessarium est, maris semen rectà affatimque emissum, foecundum esse, nec tenue vt vel serum vel aqua, nec mole exiguum, sed tale quale redditur à bene temperatis viris, non praeter modum veneri indulgentibus. Deinde verò vterum repurgatum, seminisque appetentem, auidè hoc ipsum trahere è cervice. Tertio tractum vndique amplecti ac continere, in totum conniueniente illius osculo. Ad haec vterum foecundum esse, qui ad seminis conceptionem fit idoneus. Is autem est, inquit Hippocrates, qui mediocrem ex omnibus obtinet temperaturam: nempe qui nec immodico frigore densior factus, maris semen refrigerat, oràque vasorum obstruit: nec humoris affluentia seminis foecunditatem tanquam terra palustris extinguit: nec siccior alimenti vbertatem inhibet: nec calidior semen ipsum ardore torret et exurit. In summa omnis immoderata absit intemperies. At modicè intemperati optimè commodèque generant, si coëant cum intemperatis pari exuperantia in contrarium vergentibus, sese enim temperant et certa ratione moderantur. Cum similibus autem si commisceantur, nequicquam valent producere. His ergo omnibus vniuersè concurrentibus, conceptio naturae legibus fit: neque si vnum desideretur, fieri potest vt conceptus ad absolutionem perueniat. Sterilitatis aut impeditae conceptionis causae, huius loci non sunt, quòd in praesentia ea duntaxat quae natura duce ac veluti magistra proferuntur, persequi statuimus.

Prima animalis conformatio. Cap. IX.

AGE VERÒ iam vtero conceptum sit foecundum semen, quid id deinde praestet ac moliatur enarrandum. Sunt quae non ex seminis materia procreantur: sanguinea tamen animantia è semine omnia lucem accipiunt, oriunturque hoc à mare in foeminam emisso. Maris ac foeminae foecunda semina, vbi consentanea quadam moderatione opportunè conuenient,

to burst into activity by the power of the womb: this very stimulation is conception. Avicenna and those of his persuasion erroneously thought that the power of semen burst into activity through the bodily disturbance during intercourse. So the first thing is that the womb draws in semen, it holds what it has drawn in, it conceives what it has held, just as the [P166] stomach digests the food it has drawn in and held. For as concoction is the particular action of the stomach, so conception is that of the womb. Undoubtedly anyone may be able to see from this the requirements for a satisfactory and meticulous conception. The prime need is for the male semen to be ejected straight and in sufficient quantity, and to be fertile, and not thin like serum¹³ or water, not small in bulk, but of the sort that men of sound temperament produce who do not overindulge in sexual activity. Next: a cleansed womb, eager for semen, to draw it greedily out of the cervix. Thirdly, to clasp and hold all around what has been drawn, with its mouth tightening on the whole. Further, a womb is fertile that becomes suited to the conception of semen. And this, says Hippocrates, is the one that possesses a moderate temperament from all [sources]. Of course, one that does not chill the male semen, or block the orifices of the vessels, through growing more close-knit from excessive cold. One that does not suppress the fertility of the semen with excess of moisture, as marshy ground does. One that does not restrain the abundance of nutriment, through being too dry, or bake and burn out the actual semen through being too hot. In brief, let there be no immoderate lack of balance ["intemperies"]. However, mildly intemperate people do beget very well and adequately, provided their partners are intemperate and tend with equal surplus to the opposite [extreme], and they are themselves self-regulating on a firm basis. But if united with their own like, they are incapable of producing. Therefore, when all these [factors] coincide overall, conception occurs by the laws of nature; but if one is lacking, conception cannot reach completion. This is not the place for the causes of sterility or obstructed conception, because we have decided to pursue for the moment only matters that proceed under natural guidance and control.

Chapter 9. The initial shaping of the animal.

SUPPOSE THAT fertile semen is now conceived in the womb: we should recount what it next provides and sets in train. There are creatures not procreated from the material of semen; but the animals with blood all receive life from the semen, and they begin with the semen emitted by the male into the female. When fertile semen of the male and the same of the female meet at the right

mutua quidem amicitia tanto complexu iungentur veréque permiscebuntur, vt fiat amborum vis vnica eadémque natura. Mox deinde suscitata vis illa in semine latens, huius materiam variè distrahit, eiúsque partes secernit: non enim est exquisitè vnum et omni ex parte consimile. Itaque statim primo et altero die, partes seminis tenuiores, calidiores, et spiritus magis participes, intrò et in medium totius molis se recipiunt: crassae verò ac magis terrenae illas ambiunt et circumcirca obuallant: ex quibus durioribus factis atque coactis vteri contagione et calore, obuoluentes foetum membranae proferuntur. Omnium extima ac prima fit allantoides, à farciminis specie appellata: tenuis ea quidem et inualida, et angustior quàm quae totum conceptum circumplicet et inuoluat, longis tamen et arctis processibus ad vtrunque apicem porrecta: per hanc membrana chorion dicta, vteri apicibus annectitur. Sub hac tota seminis pars exterior et magis terrena (semper enim semen sese colligit in angustum, et parte sui media vires obtinet multò maximas) qua vterum contingit, in membranam alteram concrescit, quam Latini secundas, Graeci χωρίον appellant. Semen etenim quia lentum est, et omni ex parte cohaeret, calore crassius fit et magis cogitur, ob idque externa et summa eius facies in membranae constantiam coit. Leuis autem cùm sit, vtero committitur et adhaerescit per ora vasorum quae in vterum desinunt; ea dicuntur acetabula, per quae semen alimentum ad se rapit: perforatur enim membrana, vt qua mollis adhuc et recens sit coacta. Praeter has autem et tertia quaedam amnios appellata gignitur, circumcirca vniuersum conceptum amplectens et inuoluens, valida certè et futura sudoris receptaculum. Ab his autem ad reliquum semen conuertamur. Quod intrò conclusum est tenuius, multò etiam magis calore diffunditur, hinc mox turgescit spiritum concipiens, vt inquit Hippocrates. Per id temporis quicquid in semine tenue est, id in spiritum abit, non eum quidem venti flatúsque plenum: non enim tum vterus flatu turget, aut eius disten-[P167] tione torquetur, neque per vteri ceruicem flatus vlla vis erumpit. At verò sic in spiritum id verti putamus, vt spiritus ille caloris omniúmque facultatum moderator, et primus procreationis author, in seminis medium se colligat: non enim vt multi Aristotelem interpretantur is euanescit, aut auolat à semine, sed in eo persistit omnium partium conformator et opifex, in quibus radicitus ac penitus inhaerens prima fit partium omnium natura, hásque vbi conformauerit, postea semper assistens, in omnem vitam quantum potest diutissimè et saluberrimè conseruat.

time and with appropriate moderateness, they will join and be truly mingled in mutual amity with an embrace so close that one power and the same nature is made of the two. Then presently that notable power that lurks in the semen is aroused, pulls the seminal material apart in different directions and separates its parts; semen is not precisely one and alike in every part. And so at once, on the first and second day, the thinner and warmer parts of the semen, with a greater share of spirit, contract themselves inward and towards the middle of the whole mass; the thick and more earthy parts surround these and wall them off all around; and from them, when they have grown harder and been condensed by contact with the hot womb, the membranes that enclose the fetus are produced. The allantois is formed on the outside and first, named from its form of a sausage; it is thin and weak, and too narrow to envelop the whole conceptus, being extended towards each tip in long narrow processes; it binds the membrane called the chorion to the uterine tips. Under this¹⁴ all the outer and more earthy part of the semen (semen always contracts, and possesses far its greatest powers in its central part) congeals into another membrane where it touches the womb, which is called the secundae in Latin and the chorion in Greek. Because semen is viscous and sticky all over, it gets thicker with heat and more congealed, with the result that its outer surface knits into the firmness of a membrane. Although it is smooth, it is bonded to the womb, sticking by means of the mouths of the vessels that run into the womb to end there; these mouths are called acetabula,¹⁵ through which the semen seizes nutriment to itself. The membrane is perforated, being still soft and recently coagulated.

In addition to these there is a third, called the amnion, embracing and enclosing the whole conceptus round about, certainly strong, and destined to be the container for sweat. Let us turn away from this to the rest of the semen. What is enclosed inside is thinner, and is much more pervaded with heat; hence, as Hippocrates says, it presently swells with the spirit it is taking up. During this time anything thin in the semen departs into spirit, but not the spirit full of wind [*“venti et flatus”*]; the womb is not bulging with wind at the time nor [P167] vexed by distension with it, and no power of wind breaks out through the cervix of the womb. However, we think that the conversion into spirit is such that this spirit, the regulator of heat and of all the faculties and the originator of procreation, gathers into the center of the semen. It does not vanish, or fly off from the semen, although many people take Aristotle this way, but continues in it as the craftsman fashioning all the parts, is utterly and fundamentally embedded in them, and becomes their original nature. When it has shaped them, it is always present later on, preserving them over the whole

Itaque hic spiritus non modò primum vehiculum et instrumentum est procreatricis facultatis (in eo enim constituta est summa illa diuináque vis conformati) sed etiam reliquas omnes naturales, quibus nutrimur, et augemur, earúmque auxiliarias is vnus in se omnes sustinet et comprehendit. Ex quibus planum euadit spiritus et omne facultatum genus ex semine initium originémque ducere. Hoc pacto quod nuper simplex semen erat à parentibus emissum, naturae rationem sumit: aut si explicatius hoc dici mauis, quae prius in semine sopita erat naturae vis et quasi intercepta, tum ad agendum exuscitur, dum primum id innatum sibi officium peragit, quod diximus conceptionem esse et nuncupari. Ambiguum enim est, an otiosum semen possis naturam appellare, quemadmodum nos rectè vocare solemus dormientem musicum. Itaque hic spiritus facultates habens et naturae instrumentum, tres bullas in medio semine constituit quasi guttas perlucidas, quae tum proximae sibi rudimenta quaedam et principia exhibent trium principiorum, cordis, iecoris et cerebri. Non tamen spiritus in his quasi fixus inhaeret, sed per totum seminis corpus vagatur, nunc quidem ad externa pergens, nunc verò crassiusculae iam membranae occurrens, et ad seminis medium refluens, vt ab Hippocrate commemoratum est. Nulla enim pars seminis ab huius contagione immunis est, imò hic simul cum natura quoquouersum se diffundit et cuncta tranat. Efficientis siquidem naturae vehiculum est et instrumentum, quae effingit partes singulas. Has autem quia totas per intima conformat, si verum est Aristotelis decretum, omnem actionem contagione perfici, necesse quidem est totas eas penitus attingat, neque duntaxat extrinsecus vt statuarum fctor, qui in interiores materiae partes minimè descendens, neque his manum admouens, rudes omnino et impolitas relinquit. Iam verò ad institutum reuertor.

*Vt de partium corporis principatu, ita et de conformationis ordine
magna quidem contentione certatur. Cap. X.*

ARISTOTELES VENARUM quemadmodum et arteriarum originem, et tum mouendi tum nutriendi principium cor instituens, non abs re dum sibi suisque principiis vult consentire, hoc contendit primum effingi et seorsum consistere in iis animalibus quae sanguine praedita sunt. Id enim primum cohaerere atque constare necesse est, ex quo incrementum et motus caeteris partibus accedit. Quapropter (inquit) si quid tale est, quod in animalibus inesse necesse est, in quo omnis naturae principium atque finis consistat, id primum quidem fingi et prae caeteris conformari necesse est.

of life in a very long-term and healthy fashion. Thus this spirit is not only the first carrier and instrument of the procreating faculty (that loftiest divine power of fashioning is established in it), but also is alone in holding and grasping to itself all the rest of the natural faculties by which we are nourished and made to grow, and their auxiliaries too. Hence it becomes clear that spirit and every kind of faculty derive their origin from semen. In this way the simple semen emitted not long before by the parents acquires a pattern ["ratio"] of nature, or if you want this in more detail, the power of nature previously slumbering and as it were trapped in the semen is roused then into activity, while performing that original task inborn within it, which we said was (and was called) conception. It is debatable whether you can call inactive semen a nature, in the way that we usually speak correctly of a sleeping musician.¹⁶ And so this spirit, in possession of faculties and the instrument of nature, establishes three bubbles like very clear drops in the middle of the semen. They lie close together and display certain initial stages of the three main organs: heart, liver, and brain. The spirit, however, does not stick anchored to these, but wanders through the whole body of the semen, at one time making for the outside, at another approaching what is now the rather thick membrane, and flowing back to the center of the semen, as Hippocrates described. No part of the semen escapes contact with it; indeed, it diffuses along with the nature in every direction, and passes through everything. For it is the carrier and instrument of active nature, which shapes the individual parts. Since it fashions the whole of them deep inside, if Aristotle's judgment is right that all action is brought about by contact, it must reach the whole of them within, not just outside like a sculptor, who penetrates barely at all into the insides of his material, keeping his hand off them and leaving them entirely rough and unpolished. Now I return to my theme.

Chapter 10. Great argument both about the main one among the bodily parts and about the order of their shaping.

ARISTOTLE SETS up the heart as the source of veins and arteries alike, and as the origin of movement as of nutrition, while aiming with good reason at consistency with himself and his principles. He maintains that it is first to be formed and have a separate existence, in the animals that are endowed with blood. It must be the first to cohere and exist, and from it growth and movement reach the rest of the parts. Therefore, he says, if there is anything such that it must be present in animals, to be where the source and purpose of their whole nature dwell, it must be shaped first and be fashioned before the rest. He

Eiusmodi autem cor esse ait, idque sensu primum percipi. Adhaec quum per obitum cor postremum vita priuetur, id quoque ait primum viuere. Omnibus siquidem commune est, vt quod primum constitutionem et ortum acceperit, id postremò deficiat, quasi natura decursionem reducem agens, à calce ad carceres, vnde initium sumit, redeat. Quod autem primum gignitur, id esse vitae et animae sedem, ab hoc deinde caetera membra suo quaeque ordine conformari [*sic*]. Cuius nonnulli modestiorem interpretationem subiiciunt, vitalem calorem in corde fixum atque stabilem, in seminis materiam influere, ex qua partes omnes conformat. Haec autem medici haudquaquam recipiunt, neque fatentur cor venarum esse originem: neque similaribus dissimilaribúsq; partibus motionis nutritionisve principium existere: neque id ante caetera gigni. Rursum neque nouissimè id per obitum vita omni deficere, quanuis fortasse motu concuti, calere, ac vitales functiones obtinere videatur: primum vitae genus, quod naturale ap-[Pr68] pellant, perfectiori quodam ordine statuunt homini inesse quam plantis. Hae quia aluntur et increscunt, viuunt quidem, at non vitali eo calore et spiritu, qui animalibus ex corde proficiscitur, quando nimirum nec cor, nec quicquam quod illi proportionem respondet, obtinent. Foetus ex semine recens conformatus, haud secus atque stirpium genus, iecoris beneficio viuít. Haecque illi prima est et simplex viuendi ratio, quae quoniam ad vitam animantium tuendam non satis esse potest, temporis prolapsione perfectionem quandam consequitur ex corde, quod ingenti caloris et spiritus copia hanc actionem vegetiorem absolutiorémque reddit. Solet tum temporis animantium vita, ipsáque vis et spiritus vitalis appellari, nempe quorum appulsu praestantiore quodam viuendi munere conceptum viget quàm planta. His certè rationibus conficiunt, non cor sed iecur primum viuere, et primum conformari. Haec ita quidem variè disputari solent ratione vtrinque probabili. Caeterum si de obscuris non modò ingenij acie, verumetiam obseruatione iudicandum est, conceptum intelligemus nunquam otiosum esse, sed statim initio partes omnes eius in suum quamque opus incumbere: foetus partes aequè omnes conformationis suae adumbrationem et rudimentum nancisci, licet non pariter omnes summam consequantur perfectionem. Nam ex puriore et vegetiore seminis portione quae in vteri medium concedit, loci tepore suscitatur solidarum partium materia, quae spiritus omniúmq; virium et facultatum atque etiam opificis nostri sedes est. Hic protinus quasi discusso torpore

says that the heart is of this sort, and is first to be perceived by the senses. In addition, since at death the heart is the last to be deprived of life, he says it is the first to be alive. For it is a universal characteristic that the first to have received its beginning is the last to fail, as if nature were retracing her steps, and returning from the finishing post to the starting line where she begins.¹⁷ What is first created is the seat of life and of the soul, and next the other limbs are fashioned, each in its sequence.

Some people supply a more restricted interpretation of this, that the vital heat, permanently linked to the heart, flows into the seminal material, out of which it shapes all the parts. But physicians do not accept this at all, and do not agree that the heart is the starting point of the veins, and the source of movement and nutrition for the similar and the dissimilar parts, nor that it is created before the rest; besides, [in their view] it is not the last to lose all life at death, although it may perhaps be seen to be impaired in its movement, to be warm, and to retain vital functions. They hold that the primary kind of life, what they [Pr68] call the natural one, is present in man in a more complete degree than in plants. Plants, since they are nourished and grow, are indeed alive, but not through that vital heat and spirit that proceeds in animals from the heart, since evidently they do not possess a heart nor anything corresponding to one. The fetus freshly shaped out of semen, just like the kind of plants, is alive thanks to the liver. This is its original simple basis of living, which cannot suffice for preserving the life of animals, and so as time passes it gains some completeness from the heart, which by its vast supply of heat and spirit renders this activity more vigorous and perfect. Usually at this time, the life of animals, the power itself and the spirit are called “vital,” meaning that through their influence what has been conceived thrives with a more excellent function for living than a plant does. People certainly demonstrate by these arguments that the liver and not the heart is the first to be alive and be fashioned; the arguments are generally debated thus in different ways with credible reasoning on each side. But if we should decide about uncertainties not just with the mind’s edge but also by observation, we will appreciate that what is conceived is never at rest, but right from the start each part applies itself to its own task; all the parts of the fetus acquire to an equal degree an incomplete outline of their shaping, though they are not all on a par in achieving the utmost perfection. Out of the purer and more energetic part of the semen, the one withdrawn into the center of the womb, the material of the solid parts is summoned forth by the lukewarmness of the site, and is the seat of spirit, of all the powers and faculties, and also of our fashioner [“opifex”]. Here it rises up at once, its sloth (so to speak)

exurgit, in actúsque proprios erumpit: ac primùm multo spiritu turgescens se diffundit, omniáque permeans partes varias quae sunt in semine (hoc enim simplex non est et vnusmodi, quanquam tale apparet) secernit, calidas à frigidis, tenues à crassis et terrenis, vt singulae demum in propriam naturam redeant, et his partibus effingendis suggerantur, à quibus olim decesserunt. Seminis portiones quae à tribus parentum principiis defluerunt, comparent in primis medio semine in tres quasi bullas digestae spiritu facultatéque confertae: eae rudimenta sunt iecoris, cordis, et cerebri. Ac tum etiam generans facultas seminis materiam commutat aptámque reddit efformationi: et idcirco aliae portiones crassiusculae apparent, quae in ossa abiturae sunt, aliae tenues ac liquidae, ex quibus nerui fient et venae atque membranae. Sic omnium praeformatio quaedam instituitur ad futuram conformationem. Huius operis nonnihil iam die septimo cerni potest, at multò apertius decimoquinto, quum in semine iam conspicuae sint partes et substantia et situ discretae. Post id temporis ex idonea materia conformatrix facultas opus aggressa, primùm rudia et inchoata principia, cor, iecur, ac cerebrum in propria loca seiungit, propriáque figura ac specie exornat: simul et membranae foetum obuoluentes robur nanciscuntur. Mox in his venae et arteriae effinguntur omnes in foetus umbilicum deductae, et quarum oscula polyporum modo acetabulis vteri cohaerent. Tum temporis è iecore tum vena porta, tum caua multiplici sobole dispergitur, et è corde arteria, è cerebro spinae medulla caudicis instar, è qua et nerui filis araneorum tenuiores emergunt, ventriculus, intestina, vesica, cordis inuolucrum, hyeozocua membrana, atque peritoneos, duplex meninx, omnes denique membranae firmo robore obtenduntur. Cutis concrescit omnia contegens ex ipso quoque semine, non vt quidam prodiderunt ex carne aridior facta. Ossa figuram sensimque duritiem conquirunt, ex coacto et verè concreto semine. Ab ossibus quicquid vi caloris spumae modo emanat, id partim iuxta ossium extrema reponitur, ad vinculorum conformationem, partim circumcirca et in longum effunditur, vt membrana fiat periosteios Graecis appellata. Die quidem vicesimoseptimo partes omnes et dispositae et conformatae quodammodo iam apparent, sed perfectè in maribus die trigesimo, in foeminis trigesimosexto. Hactenus sola existit solidarum partium conformatio ex puro semine, quod quantumcunque initio conceptum est à parentibus, id nihil auctum, nihil amplificatum satis est partibus omnibus conformandis. Tum inde

dispersed, and springs into its particular actions. First of all, swelling with much spirit, it spreads itself out, and pervading everything it separates off the different parts in the semen (which looks simple and uniform, yet is not so), the hot from the cold, the thin from the thick and earthy, so that individual parts end up adopting their own nature, and are assembled for the fashioning of the parts from which in the past they withdrew. The portions of semen that were derived from the three starting points [*"principia"*] of the parents appear first in the middle of the semen, divided into three (as it were) bubbles full of spirit and faculty: the initial stages of liver, heart, and brain. At this time too the generating faculty alters the material of the semen and makes it fit for shaping, which is why some parts show as rather thicker (those that are on their way to the bones), others thin and liquid, from which nerves and veins and membranes are made. In this way everything undergoes a preparation for the fashioning to come. Some of this achievement can be seen already on the seventh day, but much more obviously on the fifteenth, when parts distinct in both substance and position are already to be seen in the semen. Thereafter the shaping faculty draws on suitable material to set about its task, and starts by isolating into their proper places the rough temporary starting points, heart, liver, and brain, and embellishes them with their own shape and form. At the same time, the membranes enveloping the fetus gain strength. Presently veins and arteries are formed in these, all connected to the navel of the fetus, and their orifices stick to the uterine cotyledons like octopuses. This is when both the portal vein and the vena cava with its manifold progeny is extended out from the liver, and the aorta [*"arteria"*] from the heart, the spinal cord from the brain like the stem of a tree, out of which nerves thinner than spiders' webs emerge, the stomach, the intestines, the bladder, the heart's sheath, the undergirding membrane;¹⁸ and the peritoneum, the twin meninges, and indeed all membranes are spread out tightly. The skin that covers it all solidifies from the semen itself too, not, as some people have maintained, from flesh turned drier. Bones search out their shape and their hardness gradually, from clotted and genuinely solidified semen. Anything that emanates like foam from bones through the power of heat is in part replaced beside the bone ends, to form ligaments, and in part is poured out around and along the bones, to make the membrane known in Greek as the periosteum. On the twenty-seventh day all the parts are already visible after a fashion, shaped and in place, but perfectly so in males on the thirtieth day and in females on the thirty-sixth. So far, there is only shaping of the solid parts out of pure semen, and however little of it was conceived from the parents at the start, it suffices without any accession for the shaping of all parts. From then on,

sanguis ex vtero prolucitur, qui primum circum iecoris spermaticas fibras atque rudimentum concreescens, totam illius molem et substantiam constituit. Ita quidem saepe obseruauimus die quadragesimo eiectum foetum, semidigiti, aut vt ait Aristoteles, formicae maiusculae magnitudine verè ac prorsus confor-[P169] matum, et cuius partes omnes excepto iecore albae ac spermaticae cernebantur. Caput par erat auellanae, et maius quàm pro reliqui corporis ratione: oculi vt cancris exerti: nasus, auriculae, brachia, manus, crura, pedes, hisque secreti digiti: penis conspicuus, sub quo scrotum milij magnitudine, superiora autem inferioribus maiora, nullo ossium robore, sed flexibilia quocunque ducerentur. Omnia contexta cute tenuissima et pellucida, per quam interiora cernebantur, alba quidem omnia, fibrosa et seminis aemula, nullo carnis aut sanguinis rubore perfusa, vnum tamen iecur rubrum inerat, amplum et recens concreto sanguini persimile: in quod ex secundis per vmbilicum venae ferebantur sanguine confertae foetum posthac nutriturae. A die trigesimosexto aut quadragesimo, conformatae partes solidae nutriri incipiunt et carne fulciri, idque iecoris beneficio, quod omnibus alimentum conficit et ministrat. Sensim ergo natura carne eas implet capacitates, quae inanes inter spermaticas fibras interciderant, pictoris exemplo qui primum imaginem rudibus lineis adumbrat, mox vario pigmentorum genere illustrat et perficit. Caro igitur ex materno sanguine fibris accrescit mucosa et lenta cuique parti sua: fit autem ea tum in musculis, tum in aliis partibus, coacto frigoris vi quod in eas illabatur alimento. At verò quoniam magna est partium tum in dignitate, tum in facultatum robore varietas, fieri omnino nequit, vt gubernatrix omnium natura, omnes aequè promoueat : sed dum ipsa vniuersim in omnes vires suas exercet, accidit vt aliae partes citius, aliae tardius formam consequantur, et genitae appareant: ac tum primum vsu quodam dicere solemus naturam eas partes procreasse. Proinde si quis à veteribus conformatarum partium propositus est ordo, non agentis est naturae, sed effecti operis. Sic quidem et eximius Hippocrates de his statuit. Membra simul omnia conformantur et increscunt, nullumque prius aut posterius altero: maiora verò natura priusquam minora comparent, quum tamen nihil priora sint. Non ergo pari tempore ornantur ac perficiuntur omnia, sed quaedam citius, quaedam tardius prout quaeque ignem nutrimentumque nacta sunt. Ergo si quem in genere procreandi ordinem spectes, ea pars primum gignitur, id est genita apparet, quae dignior est,

blood is coaxed forth from the womb, and congealing first around the spermatic lobes ["fibras"] and initial stage of the liver, establishes its whole bulk and substance. We have often seen a fetus expelled in this state at the fortieth day, half a finger's breadth [long], or as Aristotle puts it, the size of a biggish ant, truly completely [P169] formed, and all parts were visibly white and spermatic, except the liver. The head was the size of a hazelnut, and too big in proportion to the rest of the body; eyes protruding like a crab's; nose, ears, arms, hands, legs, feet (with separate toes); penis conspicuous, and under it a scrotum the size of a millet seed, the upper parts larger than the lower, no strength in the bones, but they would bend in whatever direction they were pulled. Everything covered with a very thin translucent skin, through which the insides were visible, all white, fibrous, and like semen, imbued with no redness of flesh or blood, although the liver inside was alone red, large, and like freshly clotted blood; into it veins ran from the afterbirth through the navel, full of blood and for the later nourishing of the fetus.

From the thirty-sixth or fortieth day, the solid parts, now shaped, start to be nourished and propped up by flesh, thanks to the liver, which creates and serves up nutriment to all of them. So nature fills flesh gradually into these cavities that had intervened as empty spaces between the spermatic fibers, like a painter who starts by sketching in the picture with rough lines, then embellishes and completes it with a diverse kind of pigments. Flesh is added to the fibers from the maternal blood, slimy and sticky, to each part its own flesh; it is formed in both muscles and other parts when the nutriment gliding into them has clotted through the power of cold. However, as the parts differ a great deal both in importance and in the strength of their faculties, it is totally impossible for nature, the controller of them all, to advance them all equally; she does exert her powers on them all overall, but some parts do happen to take on their form and be visibly generated more quickly, and others more slowly. We usually say that nature brought these parts into being first at that time for some use. Accordingly, if a sequence of the shaped parts was laid down by the ancients, it is not that of nature the doer, but that of the completed work. This is what the distinguished Hippocrates too laid down about them. The limbs are all formed and grow simultaneously, none before or later than another; but those that are bigger by nature make their appearance before the smaller ones, though they have no [real] precedence. So everything is not embellished and completed in equal time, but some faster and some slower, according as they acquired fire and nutriment. So if you examine the general order of procreation, the part that is first begotten, that is, is seen to have come into being, is the more important

motúsque principium in se obtinet: valentiore enim ea facultate, tum generante, tum propria agente praedita est. Post hanc verò caeterae, quae illi sunt vtilēs, et quae illius gratia consistunt. Sic igitur superiora inferioribus, interiora externis, et spermatica sanguineis prius orta apparent: ac inter illa quaecunque praestantiora sunt, priora sunt caeteris, licet saepe posterius compleri ac perfici cernantur. Sic enim tres principes partes cor, iecur, et cerebrum, priusquam umbilicus aut caeterorum quicquam, procreationis suae primordia sumunt, tametsi omnium primus umbilicus perfectè consistit. Hac igitur via et ratione, quid post quod fiat quaerendum est.

De foetus perfectione et complemento. Cap. XI.

SPECIE ATQUE forma modò adornatus foetus, totus tenellus est, omnique ex parte prae immodico humore lentus et muci plenus, ob idque ad omnes actiones minus accommodatus. Reliquo deinceps tempore, dum vi caloris assiduò aridior fit et siccior, cuncta firmantur, membranae, nerui, atque cutis, ungues in extremis digitis, ac pili in capite radices agunt. Sensus autem facultate foetus illustratur circiter diem sextum et trigesimum. Vbi autem iam ad mensem tertium mas peruenerit, foemina verò ad quartum, firmatis ossibus ac paulò durioribus factis, moueri inquit Hippocrates, ac calcitrare incipit. At certè siue mas siue foemina geritur, aliae praegnantēs semper die quadragesimosecundo, aliae mense tertio, aliae non nisi medio praegnationis cursu eum loco dimoueri sentiunt. Eadem quoque praegnans aliàs secundo et quadragesimo die, aliàs quarto mense primos motuum insultus obseruat, quum quasi volitantis muscae excussionem vel titillationem percipit. Tanti causa discriminis non sexui, sed vel robori bonaeque constitutioni foetus, vel praegnantis naturae tribuenda est. Quanquam hoc tempore vnaquaeque particula conformata apparet, nondum tamen integrè [P170] consummata est atque firma. Proinde hinc ad nonum ovské mensem, quo foetus lucem ortúmque accipere consuevit, perficiuntur singulae, nutriuntur et increscunt. Tum deinde quum foetus id magnitudinis et roboris consequutus est, vt seipso regi et ore sumptum alimentum conficere valeat, amplior factus, vberiorémque cibum expostulans et aërem ampliorem, quem ad natiui caloris refrigerationem spiritu ducat, viam et egressum ipse sibi facit. Vtero gestatus, incuruus totus ac contractus, talos ad nates applicat, manibus genua apprehendit, in quae caput sic dimittit,

one, with a source of movement in it; it is the one endowed with the stronger faculty that both brings into being, and performs its own actions. And the rest follow, which are of use to it and owe their existence to it. In this way the upper parts start and are visible before the lower, the internal before the external, and the spermatic before the sanguineous; among these those that are more excellent precede the rest, although often found to reach completion later. Thus the three main parts, heart, liver, and brain, procure the rudiments of their generation ahead of the navel or any of the rest, although the navel reaches completeness first of them all. On this line and basis we must find out what happens after anything.

Chapter 11. The completing and filling out of the fetus.

NOW PROVIDED with a form and shape, the fetus is all soft, and viscous and full of mucus everywhere, through excess of moisture, and consequently less suited for all activities. In the rest of the ensuing time, as it grows continually drier through the power of heat, everything is strengthened, membranes, nerves, and skin, nails on the fingertips; and hairs on the head put down roots. The fetus is embellished with the faculty of sensation around the thirty-sixth day. When the male has reached the third month and the female the fourth, with bones grown stronger and a little harder, Hippocrates says it begins to move and kick. Certainly, however, whether a male or a female is being carried, some pregnant women always feel it shift its position on the forty-second day, others in the third month, others not until the middle of the pregnancy. Again, the same woman when pregnant on one occasion notices the first impacts of movements on the forty-second day, on another occasion in the fourth month, when she perceives something like the shake or tickle of a fly's flight. The reason for such a difference is not to be assigned to the sex, but either to the strength and sound constitution of the fetus, or to the nature of the pregnant woman. Though at this point each small part is visibly shaped, it is not yet entirely [P170] complete and strong. Accordingly, from now till the ninth month, when the fetus has normally received its life and beginning, the perfecting, nourishment and growth of the individual parts goes on. Next, when the fetus has reached the size and strength to be able to dispose of food taken by mouth under its own control, has grown larger, and is demanding more abundant food, and more spacious air to breathe ["spiritu ducat"] for the cooling of the innate heat, it makes a way out for itself. Carried in the womb, all curled up and squashed, it touches its buttocks with its ankles, it grasps its knees with its hands, and lowers

vt oculi manuum pollicibus veluti affixi haereant, nasus verò inter genua procumbat. Prior corporis pars, in matris abdomen, posterior in dorsum vergit, si mas geritur: nam foeminae aduerso situ collocantur. Hac autem ratione alitur foetus in vtero. Singulis acetabulis tum venarum tum arteriarum ad vterum pertinentium alia adnata sunt vasa carne suffulta per secundarum medias regiones dispersa, quae tandem in vmbilicum coeunt, ex quibus foetus sanguinem et spiritum assiduo rapit. Duae siquidem in vmbilico cernuntur arteriae, in ramos arteriae maioris lumbis subiectos insertae. Totidem venae ex vmbilico, in vnam coeunt, et in iecoris caua pertinent: vt qui per has ex secundarum venis tanquam ex radicibus (alitur enim foetus auctore Hippocrate vt cuncta humi nascentia) tractus est sanguis, rursum in foetus iecore perfectionem suscipiat, et quasi noua mutatione familiare illi fiat alimentum. Hinc per venam cauam quoquoersum deriuatus, partibus singulis pastionem affert: omnes quippe hinc alimentum capessunt. Concoctione iecoris quae perfectior quaedam est αἰμάτωσις, quatuor humorum differentiae gignuntur in foetu, haud secus ac in adultis. Vrina licet pauca (quo enim sanguine foetus alitur, is iam in matre ab vrina magna ex parte fuerat purgatus) in renes et vesicam secernitur: hinc autem effluit, non quemadmodum nobis per vesicae ceruicem, sed eo ductu qui in fundum⁶ vesicae inseritur, redundat in vmbilicum, illincque spargitur sub membranam allantoeidem, vbi collecta seruatur ad pariendi tempus. Alterum vniuersi corporis excrementum, quod sudor est, sub amnion membranam excipitur, eoque foetus circumfusus est vt cutem vsquequaque contingat. Inter allantoeidem tunicam et chorion nihil incidit, sed hae quasi continuatae sunt. Nullum excrementum ex aluo foetus deponit, cum neque ore cibum capessat, neque ventriculo concoquat: tametsi recens in lucem editis ex aluo elabitur quippiam simile crasso, nigro, et lutulento sanguini, quod iecoris recrementum est, ex cuius cauis in intestina exciderat, in quibus cumulatum seruabatur in pariendi tempus. In hunc igitur modum alitur, augetur, perficiturque foetus. Caeterum circa nonum mensem factus grandior, copiosiore (vt dixi) egens alimento et spiritu, diutius concludi non patitur. Proinde primum sese conuoluit, caputque declinans pudendo offert, crura ac reliquos artus in sublime distendens. Id autem nonnunquam molitur vno mense ante partum. At sic se inuertens

its head onto its knees so [fully] that its eyes adhere to its thumbs as though stuck to them, and its nose lies between its knees. If a male is being carried, its front part faces the mother's abdominal wall ["abdomen"] and its back her back; females lie the other way round. The fetus is nourished on the following basis in the womb. On individual cotyledons of both veins and arteries related to the womb, other vessels have developed, shored up by flesh and distributed through the middle regions of the afterbirth; they end up assembling at the navel, and the fetus eagerly snatches blood and spirit from them. For there are two arteries visible in the navel, implanted into the aortic branches lying on the loins. The same number of veins from the navel run into one, and reach the hollow of the liver, because the blood drawn through them from the veins of the afterbirth, as if from roots (Hippocrates is our authority that the fetus is nourished like all things coming to birth on the earth), undergoes further completion in the fetal liver, and turns into its congenial nutriment, by a sort of new change. Led from there along the vena cava in every direction, it conveys pasturage ["pastio"] to the individual parts; they all grasp their nutriment from here. Through the liver's concoction, which is a more complete sort of blood-forming ["haematosiis"], four different humors are generated in the fetus, just as in adults. Urine (but not much, because the blood nourishing the fetus had already been largely cleared of urine within the mother) is filtered off into the kidneys and bladder, and runs out from there, not through the neck of the bladder as in us, but by the duct that is introduced into the fundus¹⁹ of the bladder; it runs off into the navel, and from there is sprinkled under the allantoic membrane, where it is kept together until the time for giving birth. The other waste of the whole body, sweat, is held under the amniotic membrane, and envelops the fetus so as to touch its skin everywhere. Nothing falls between the allantoic coat and the chorion; the two are virtually contiguous. The fetus sheds no waste from the bowel, since it takes no food by mouth nor digests any in the stomach; nevertheless, in the newborn there slides out of the bowel something like thick black dirty blood, which is the refuse of the liver; it had slipped out of the liver's recesses into the intestines, and the accumulation was stored there until the time for giving birth.

This is the way in which the fetus is nourished, grows, and is brought to perfection. But around the ninth month, grown large and in need of more plentiful nutriment and spirit, as I mentioned, it does not tolerate longer confinement. Accordingly, it begins by coiling up, and bends down its head to present it at the private parts, extending its legs and other limbs upwards. It sometimes sets about this a month before birth. In turning upside down in this

nihil defringit, quod laxior sit vmbilicus, duos plerunque cubitos longus, multis modis et inuolucris foetum praecingens. Instante partu ille calcitrans, primum amnion membranam manuum pedumque crebra impulsione dirumpit, ac tum miscetur vrina sudori. Post haec verò maiore impetu sese conuolutans, plurima acetabula dissoluit, quo tempore mater ventris tortiones experitur, defluitque sanguis in vteri capacitatem. Postea verò secundae ab acetabulis euelluntur, et reliquae discerpuntur membranae, ac tùm aquae ex vtero defluunt: cùmque nil amplius haeret foetus, excidit ceu maturum malum ab arbore, soluto sponte pediculo. Haec quidem foetus molitur. Vterus verò qui nouem continenter mensibus tota ceruice connixerat, foetum auidè comprehendens, tum os paulatim aperit, ac primum quidem ita diducit, vt obstetricibus minimum in id digitum immittere liceat, dehinc verò amplius, vt obstetrices allantoeidem tunicam, et quas vocant aquas ori obuias percipiant. Ab his verò ore ad foetus prolapsionem satis patente, vniuersus vteri fundus, quamproximè potest ad os se contrahit, foetumque foras propellit, cui et aliae quae circumstant partes suppetias ferunt. Ipsa quoque mulier non mediocriter sibiipsi opitulatur, et viribus connititur ad foetum strenuè excludendum, contractis intentisque his qui in abdomine sunt musculis. Foetus in os vteri delapsus, capite corpori viam parat, séque foras dat per lubricam ceruicem, vt quam copiosus effluens humor persuderat. Multa igitur in tam difficili arduoque [Pr171] opere conueniunt, foetus, mulier, et vterus, quem ipsi aliquando vidimus tanto impetu foetum extrudere, vt simul foras excideret. Quo autem pacto os vteri tantopere dehiscat, vt per id foetus elabatur, nescit Galenus, nec aliud quàm admirari potest.⁷ Auicennas tamen in ea est opinione, vt existimet pubis ossa tum necessariò seiungi, horumque commissuram quasi dissolutam patere: quod tamen fieri nulla ratione potest, nec est vsu deprehensum: rectum tamen intestinum et podicem grauissimè premi constat. Ita quidem ex naturae praescripto paritur infans, mas quidem facie ad matris podicem, foemina verò ad partes obscoenas conuersa, quoniam in vtero illis quoque contrarius situs erat. Foetus exitus angustia secundas exuit et inuertit, quae et mox foetum sequentes cernuntur vmbilicum foris habere. Vix dum editus infans eiulans vociferatur: ac sine magistro, duce natura lac è mammis exugit, quod eò magna prouisione reconditum fuerat. sanguis [sic] enim qui mensibus singulis excerni consueuerat, subsistit non in ipso quidem vtero (illic

way, it does not break anything off, because the umbilical cord is too slack, two cubits long as a rule, girdling the fetus with manifold sheaths. When birth is imminent the fetus kicks, and breaks up the amniotic membrane for the first time with frequent blows of its hands and feet; this is the time when the urine is mixed with the sweat. Then, twisting itself with a greater effort, it breaks up numerous cotyledons, while the mother is suffering pains of the belly, and blood is running down into the uterine cavity. Subsequently the afterbirth is torn from the cotyledons, and the remaining membranes are pulled apart, and then the waters run out from the womb. When the fetus does not adhere any longer, it drops out like a ripe apple from a tree when its stalk snaps of itself. The fetus sets this going. The womb had kept its whole cervix tight shut continuously for nine months, grasping the fetus greedily; then it opens its mouth little by little, dilating at first enough to let midwives insert a little finger into it, then more widely, so that midwives see the allantoic coat, and what they call the waters in front of the mouth of the womb. Next, with the mouth wide enough open for the fetus to slip out, the whole of the uterine fundus contracts as closely towards the mouth as it can, and drives the fetus out; the other surrounding parts lend assistance. The mother too gives herself considerable help, and with her strength struggles vigorously to oust the fetus, by contracting and tensing her abdominal muscles. Having slid into the mouth of the womb, the fetus makes a path for its body with its head, and gets itself out through the slippery cervix, which the abundance of escaping moisture had wetted. There are many contributors to such an exacting [P171] enterprise: the fetus, the mother, and the womb; we have sometimes seen the womb eject the fetus with such vigor as to be slipping out along with it. Galen does not know how the mouth of the womb can gape enough for the fetus to slide out through it, and can but marvel. Avicenna, however, is of the view that the pubic bones must separate at the time, and their junction must open as if it had broken down. But there is no basis on which this can happen, and it is not found in practice. However, it is agreed that the rectum and anus are severely compressed. This is the way in which the infant is born according to nature's rule: a male with the face turned towards the mother's anus, a female towards her private parts, since their position in the womb was opposite too. The way out being narrow, the fetus strips off the afterbirth and inverts it; it presently follows the fetus and is seen to have the umbilical cord on its outside. When the infant is only just delivered, it wails loudly, and without any teacher, is prompted by nature to suck from the breasts the milk that had been stored there with great foresight; blood that had usually been excreted each month does not remain in the womb itself (where it

enim concreceret in grumum) sed in venis maioribus. Hic in vniuersum corpus redundans in tres distribuitur portiones. Prima ea est quam foetus per acetabula vi sua pro alimento trahit, haecque non modò menstrui, sed etiam totius materni sanguinis (vt Auenzoari credimus) pars est syncerissima et longè optima. Altera sanguinis portio, nullo item contaminata vitio, cùm primùm foetus mouetur in mammas concedit, vt naturae mutationibus in lac conuersa, recens nato infanti familiare et conueniens suppeditet nutrimentum. Tertia in ipso iam partu et multo pòst tempore copiosè è venis per vterum dimanat. Tres eae portiones in superuacuo mulierum sanguine continentur, et mensibus singulis naturae impulsu foras exturbantur, hincque menstruorum nomen inuenerunt. Vna tamen ea portio quae in pariendi tempus reseruata foras propulsatur, verum est menstruum nutritioni ineptum, non molis tantummodo copia, verumetiam qualitate noxium et infestum. Tanta autem cùm sit menstrui perniciēs, quemadmodum suprà diximus, mulier si à partu non commodè expurgatur, vita est in discrimine. Qua ratione motus Hippocrates, nec dies viginti, nec quinque et viginti, mulieri expurgandae satis esse pronuntiauit: verùm omnino aut duos et quadraginta, aut certè triginta. Quaecunque grauidis sub partum incidunt symptomata, maximè verò malacia, cordis dolor, et appetentiae deiectio, omnia verus hic menstruus humor prorsus accersiuīt. Veterum diuturna obseruatione animaduersum est, mulierem quae profluentibus menstribus fortè conceperit, foetum edere ad elephantiasin propensum: definitumque est à quibusdam, quoto aetatis anno illa in conspectum se dabit. Huius causam statuunt, quòd per id temporis foetus necessariò augetur et increscit ex menstruo prorsum vitioso et corrupto, quod suae perniciēi radices agens tandem suam prodit malignitatem. Si verò haud ita multum antè quàm menses erumpere consueuerunt mulier concipiat, quoniam iam quiddam in venis huius est menstrui, in lucem proferetur infans in multos certè morbos procliuis. Foeliciter autem et integra sanitate hic ortum accipiet, quem nuper expurgata mulier conceperit: nisi aliunde à parentibus vitium quasi haereditate contrahat. Iam de infantis figura et similitudine.

Quibus ex causis fit, vt nati parentibus similes dissimilēsve sint. Cap. XII.

HUIUS QUAESTIONIS ardua et tanta obscuritate involuta est inuestigatio, vt quicumque in hac versati sunt veteres, de causa dissentiant. Quò autem

would clot) but in the greater veins. Overflowing there into the whole body, it is divided into three portions. The first is what the fetus draws as food through the cotyledons by its power, and this is, if we believe Avenzoar, the purest and far the best not only of the menstrual blood but also of the whole of the mother's blood. The second part, also undefiled, makes for the breasts at the first fetal movement, to be converted into milk by nature's alterations, and supply congenial and suitable nutriment to the newborn infant. The third dribbles away plentifully during birth itself and for long afterwards, out of the veins and through the womb. These three portions are included in the excess maternal blood, and are expelled each month at nature's prompting; hence they have acquired the name "menstrual."²⁰ Only the portion that is expelled after being stored for the time of giving birth is truly menstrual, and unsuitable for nutrition, not just through the abundance of its bulk; it is also harmful in its quality. As the menstrual blood [if not voided] is a source of destruction as great as we have mentioned, if the woman is not appropriately cleansed by giving birth, her life hangs in the balance. On this line of thought, Hippocrates announced that neither twenty nor twenty-five days were enough for a woman's cleansing, but forty-two days all told, or anyway thirty. All the disorders ["symptomata"] that afflict pregnant women before delivery, but especially pica ["malacia"], cardiac pain, and depression of appetite, are entirely introduced by this true menstrual humor. Prolonged observation by the ancients noted that a woman who has happened to conceive during menstruation produces a fetus liable to elephantiasis; some of them have fixed the year of [the child's] age at which elephantiasis will display itself. The cause they lay down for this is that the fetus at that period has to do its growing from totally faulty and corrupt menstrual blood, which puts forth the roots of its own destruction and in the end transmits its own malignancy. If, however, the woman conceives not so long before menstruation has normally started, there is already some of this menstrual blood in her veins; an infant will be brought to life with assuredly an inclination to many diseases. The infant conceived by a woman recently cleansed will receive its start with good fortune and intact health, unless it incurs a fault from its parents in some other way, by (so to speak) inheritance. Now about the shape and likeness of the infant.

Chapter 12. The reasons children are like or unlike their parents.

INQUIRY INTO this question is wrapped in such challenging obscurity that the ancients who concerned themselves with it differ about the cause. To pass over

haec breuiter summatimque perstringam, omitta Aristotelis de hisce sententia, triplex in primis similitudinis genus commemorem, vnum in specie, alterum in sexu, tertium in effigie. Quae in specie existit similitudo, maximè ex subiecta materia proficiscitur. Hinc quod ex animalium diuersi generis concursu progignitur, propiùs ad foeminae quàm ad maris speciem accedit. Vt ex oue et hirco, ouis gignitur pilis duris et longis consita: contrà verò ex capra et ariete, capra fit pilis mollioribus: haecque proportio retinebitur, si canis et vulpes, vel asinus et equa coëant. Qui certè euentus argumento est, multò copiosiore[m] [P172] foetui materiam á foemina quàm à mare conferri. Cùm autem mas nihil nisi semen suppeditet, consequens est ipsum quoque semen foetui pro materia subiici: alioqui foetus matrem omnino exprimeret et specie referret, quod perspicuè falsum est et inane. Sexus porrò ex temperatura et moderatione agentium et principum quae in seminibus insunt qualitatum emergit. Si enim vtriusque parentis semen calore siccitatèque plurimùm excellat, mas procreabitur: contrà si frigus humórque vincat et exuperet, foemina. Sexus discrimen non solùm ex partibus obscoenis, sed etiam ex reliquo ferè corpore spectatur: ex barba, partium amplitudine et voce. Ergo ex robustis parentibus, calidis, si temperantia quadam venerem exercent, mas ferè exuscitatur: rursúmque à dextri testiculi semine, et in dextro vteri sinu, mares, à sinistris verò foeminae. Formae et effigiei similitudinem robori facultatis conformantis, quae in semine opifex est, Galenus refert acceptam. At ne quis inferat, oportere semper foetum patri similem gigni, quòd patris semen validius sit materno: inquit foemineum quandoque praepollere, propterea quòd nouem mensium spatio vim plurimam sumit ex menstruo, atque hinc accidere ait vt foetus nonnunquam matri similes euadant, aut interdum vna parte matrem, altera patrem repraesentent, cùm neutrum semen reliquum prorsus euincit. Haec autem sententia vix sibi constat, quòd effectricem conformatricè[m]que vim non modò foemineo semini, sed ipsi quoque menstruo concedat. Sed neque ex iis rationibus causam reperiet, quamobrem foetus plerunque alterius ignoti speciem similitudinè[m]que gerat, qui nihil ad procreationem contulit. Quum etiam mas matris effigie in lucem editur, rationem statuit, quòd in vtriusque semine calor et siccitas excellent: quae pudenda foras protrudant, ac reliqua depromant quae masculi sunt sexus, sed tamen inquit

it in summary brevity, I shall omit Aristotle's view of it, and describe in the first place a threefold kind of likeness: likeness in form ["species"], likeness in sex, and likeness in outward appearance. Likeness in form proceeds mostly from the subject material. Hence a creature begotten by the intercourse of animals of different kind approaches the form ["species"] of the female more than that of the male. For instance, from a ewe and a he-goat a ewe is begotten covered with long hard hair, but from a nanny goat and a ram a nanny goat with softer hair; and this analogy will hold if a dog and a vixen, or a donkey and a mare, copulate. This outcome is evidence that a much greater abundance of material is contributed to the [P172] fetus by the female than by the male. And since the male contributes nothing but semen, it follows that the semen itself too is supplied to the fetus as material; otherwise, the fetus would entirely reproduce the mother and resemble her in form, which is manifestly untrue and futile. Again, sex develops from the temperament and moderateness of the active main qualities present in the semens. For if the semen of either parent is very outstanding in heat and dryness, a male will be procreated; conversely, if coldness and moistness have the upper hand, a female. Difference in sex is assessed not just from the private parts but also from almost the whole body: the beard, the size of parts, the voice. Thus a male is usually induced from strong hot parents, practicing intercourse with a measure of control; in addition, males from the semen of the right testicle, and in the right uterine cavity; females from the left.²¹ Galen assigns likeness of form and outward appearance to the strength of the shaping faculty, which is the fashioner in the semen.²² But let no one conclude that a fetus similar to the father should always be begotten, because the paternal semen is stronger than the maternal, [for] he says that at times the female semen predominates, for the reason that over the period of nine months it acquires a great deal of power from the menstrual blood, and he states that this is the reason that fetuses at times turn out like the mother, or upon occasion they resemble the mother in one part and the father in another, when neither semen entirely gets the better of the other. It is hardly a consistent view to hand over the active shaping power not just to the female semen, but to the menstrual blood itself.

But these considerations will not show him the reason either that a fetus frequently displays the form and likeness of another unknown [person], who has contributed nothing to the procreation. When a male is born with the outward appearance of the mother, the reason he suggests is that heat and dryness are prominent in the semen of both; they serve to thrust the private parts outwards, and deploy the rest of the male features; but on the other hand, he says that in

in foemineo vis effingendi praepollet. At si vis haec (vt idem quàm pug-
nacissimè tutatur) temperamentum consequitur, quì fiet vt masculum semen
temperamento sit potentius, fingentem autem facultatem habeat im-
becilliozem? aut vndénam accidere possit, vt tanta vis conformandi insit
foemineo semini, quod nihilominus constanter asseuerat crudum esse, frigidum
et aqueum, sempérque masculo imbecillius? Probabilius est igitur, vehementi
comprehensione et firma grauidarum cogitatione vim eam quae foetum confor-
mat, duci atque gubernari. Huius enim quae potissimum data est hominibus,
tanta vis est et potestas, vt sicuti plerunque corpus cogitantis immutat, sic et in
conceptum semen vim suam conferat. Hoc testimonio quòd dum mulieri quae
nuper vtero conceperit, vel cerasum, vel fragum, vel vinum in sinum effundetur,
si animo id grauiter ferens vehementer apprehendat, ibidem infanti nota in-
uretur. Par ac similis est eorum ratio, quae in malacia accidunt, si grauida eo
cuius flagrat desiderio minimè potiatur, infans illius signum geret. Veterum
etiam literis proditum est, mulierem albam, prolem nigram genuisse, hinc
duntaxat, quòd fixis oculis intentòque animo diu Aethiopis imaginem com-
prehendisset. Si pauo dum ouis suis incubat, linteis albis circumtegatur [*sic*],
albos omnino pullos, non gemmantis coloris edet: quemadmodum etiam gal-
lina colore varios emittet, si variè picta oua foueat. Haec quum multorum
animaduersione comprobata sint, similitudinis quae in effigie est, ea iusta causa
videri potest, quam Plinius commemorat, è celebri quopiam authore
depromptam. Hausta (inquit) imago sub ipso conceptu, similitudinum reput-
atio est. Cogitatio enim vtriuslibet parentis animo subito transuolans, effingere
similitudinem existimatur. Hinc alios auis similes, alios patribus enasci vid-
emus: nonnunquam ex albis parentibus in Aethiopem partum ipsum
degenerare. Sùntque plures in homine, quàm caeteris omnibus animalibus
differentiae, quoniam velocitas cogitationum, animique celeritas, et ingenij
varietas, multiformes notas imprimit: quum cunctis animalibus immobiles sint
animi et similes omnibus, singulísque in suo cuique genere. Haec ille, quibus
ego prorsus assentior, et verè vt loquar, omnino mihi persuadeo, vim formae
effectricem à cogitatione duci et ab ea vna regi. Atque haec de similitudinum
causis, in quibus neque vitiosas neque monstrosas affectiones quae praeter
naturam sunt, intelligi velim. De gemellis nunc reliquum est, vt breuiter
disseramus. Si quod semen vir eiaculatur, statim dilapsum vteri sinus am-
bos ex aequo

female semen the power of fashioning predominates. Or, if you prefer [to think that] the temperament brings about these results (as he belligerently maintains), how does it come about that male semen is more powerful in temperament, yet has a weaker fashioning faculty? How can it happen that there is such a fashioning power in female semen, yet he steadily asserts that it is unrefined, cold and watery, and invariably weaker than the male's? So the likelihood is that the power that shapes the fetus is guided and regulated by the strong grasp and steady thinking of pregnant women. This thinking, a special gift to humanity, has such power and potentiality that in just the same way as it often alters the thinker's body, it contributes its power to the conceived semen. The evidence is that when a cherry or strawberry or some wine is spilt into the bosom of a woman who has recently conceived, then if she is very upset and seizes it violently, a mark will be burnt into the infant at that point ["*ibidem*": either of time or of space]. Just the same is the state of affairs in *pica* ["*malacia*"]: if what the pregnant woman hotly desires is totally beyond her reach, the infant will bear the mark of it. It is recorded in the literature of the past that a white woman bore a black offspring just because she had fixed her gaze and full attention for a long time upon a picture of an Ethiopian. While a peacock is incubating her eggs, if she is covered over with white cloths, she will bring forth chicks entirely white, not of brilliant color; in the same way too a hen will produce chicks of varied color if she broods eggs variously painted. Since these findings are endorsed by the observation of many people, the correct cause of resemblance in outward appearance can be seen to be the one Pliny recounts, borrowing it from some famous authority. The image, he says, that was absorbed in the course of actual conception is the thing to bear in mind in relation to resemblances [meaning uncertain]. For it is believed that a thought of either parent, flitting across impromptu ["*animo subito*"], shapes the likeness. Hence we see some people born resembling their grandfathers, others their fathers; sometimes the offspring of white parents itself reverts to an Ethiopian. And there are more points of distinction in a human being than in all the rest of the animals, because speed of thought, nimbleness of mind ["*animus*"], and diversity of talent impose marks of many sorts. For in all the animals the minds are unmoving, and alike in all and in each in its own kind. This is what he said; I am in complete agreement, and to tell the truth, am totally convinced, that the power that fashions form is derived from thought and is controlled by it alone.²³ And this is what I would like to be understood on the causes of likenesses, in the absence of flawed or monstrous preternatural dispositions. It remains now to discourse briefly about twins. If the semen ejaculated by the man slides up at once into both uterine cavities [P173] equally, and is kept

subeat: hísque conclusum foueatur, affluente tum muliebri semine, gemelli procreantur, authore Hippocrate, quanquam Aristoteles aliam causam refert. Si aequa partitio non est, contingit molam cum foetu haberi. Qui gemelli vnus sunt sexus, iisdem secundis inuoluti, simplici duntaxat membrana seiunguntur, suum quisque tamen vmbilicum, propriásque tum venas, tum arterias obtinet. Qui verò diuersi sunt sexus, diuersas quoque secundas acceperunt, eásque prorsus diremptas. Ergo locorum in quos seorsum semen inciderit distinctio, foetuum numerum designat: quos (tametsi complures erunt) vnus idémque concubitus instituit. Si enim postea ex alio congressu semen vtero concipitur, quod mulieri perquam rarò, canibus autem et aliis plerisque animantibus frequentius accidit, gemelli non fiunt, sed ea fit quae superfoetatio dici solet. Non enim vno tempore, sed dierum interiecto numero aeduntur⁸ ij foetus: éstque vt concipiendi sic et pariendi tempus varium. Corporis moles ad alimenti sanguínisque materni bonitatem et vbertatem, amplitudo solidarum partium ad paterni seminis copiam, proceritas ad eius naturam refertur: ea enim plerunque artus ad iustam parémque magnitudinem porrigit. Mulier eadem ex pusillo viro pusillum, ex procero procerum foetum parit: rarò tamen vir ex diuersis mulieribus dissimilem magnitudine prolem suscitatur.

Vnde et quónam ordine animae facultates conceptui tanquam genitae accedant: nec esse praeterea dubitandum an semen pars fiat conceptus. Cap. XIII.

POSTEAQUAM VNIUERSAM foetus procreationem sumus exequuti, tempestiuè postremo loco de animae viribus et earum ortu (quisquis est) disseremus. Repetenda autem sunt quae semini inesse demonstrauiamus, nempe foecundum, animam in se continere, tum naturalem, tum sensus participem, idque potestate non reipsa et energia. Nemo enim semen animam iam habere, vt neque profectò animal esse dixerit, quod tamen vt euadat, potestatem et vim habet. Praeditum enim est diuino et coelesti calore, qui non in elementis, sed in spiritu quodam est aethereo. Hic autem spiritus sentientis animae sedes est et vehiculum primúmque agendi instrumentum: atque in omne seminis corpus penitus immergitur, eíque foecunditatem conciliat. Hic à corpore inseparabilis est, nec per se potest solus constare, vt neque anima cuius est sedes. Quòd si à materia nunquam seiungitur

snug shut up in them, then when the female semen runs in, twins are engendered, according to Hippocrates, though Aristotle assigns a different cause. If the division of the semen is not equal, the outcome is that a mole exists along with a fetus. Twins of the same sex, enveloped in the same afterbirth, are separated just by a simple membrane, but each possesses its own navel and its particular veins and arteries. But twins of different sex have received different afterbirths, totally separate ones. Thus a difference in the places into which the semen separately settled determines the number of fetuses; even if there are several of them, one and the same intercourse originated them. For if semen is conceived in the womb later on, from another act of intercourse (as occurs very rarely in a woman, but more often in dogs and in most of the other animals), twins are not formed, but the result is what is usually called a superfetation. Two fetuses are brought forth, not at a single time, but with a number of days between them, and it is the case that the time of conception being different, so is the time of delivery. The bodily bulk is related to the goodness and abundance of the maternal food and blood; the extent of the solid parts to the supply of paternal semen; and the height to its nature, which is what usually extends the limbs to a correct and equal size. The same mother bears a little fetus to a little man, and a tall one to a tall man; it is rare, however, for a man to beget offspring differing in size from different women.

Chapter 13. The source from which the soul's faculties accrue to the conceptus, as if begotten, and the sequence in which this occurs; in addition, it is beyond doubt that the semen is a part of the conceptus.

NOW THAT we have gone through all of the procreation of the fetus, it will be the right time to discuss as the last item the powers of the soul and their origin, whatever it is. Let us recapitulate what we proved was present in the semen: fertile semen includes soul, both natural soul and soul with a share of sensation, and includes it in potentiality, not in reality and actuality. No one has said that semen already possesses a soul, anymore indeed than that it is an animal; but it possesses the potentiality and power to emerge as one. For it is endowed with a divine and heavenly heat, not in its elements, but in a sort of ethereal spirit. This spirit is the abode and carrier of the sentient soul, and the primary instrument of taking action; it is entirely sunk into the whole of the body of the semen, and procures fertility for it. It is inseparable from the body, and cannot exist alone on its own, nor can the soul whose abode it is. If however the soul is never parted

anima, neque ea diuinitus, neque aliunde extrinsecus accessit. Quocirca ut in omni animantium genere mas praecipuam seminis substantiam, ita sanè et animae vim statim primo ortu vnà cum spiritu confert. Primum tamen in semine delitescens, sensum latet, nec magna ex parte cernitur, quo tempore potestate dicitur inesse: at in progressu vteri vi excitatur, et opere se ostendit. Nam mox simul ac semen concipitur, vis conformandi exurgit, quam nonnulli aiunt velut idolum quoddam et ideam generantis esse. Haec ubi foetum totum conformauerit, superuacua omnino intercidit et euanescit, ut multorum fert opinio: at verò quoniam postea in adultioribus dentes gignit atque profert, rectius putem illam seruari, sed idcirco otiosam, quòd ei desit materia. Nutriendi insequitur facultas perpetua, et quae nunquam viuum animal deserit. Haec à parente defluens non (ut putauit Auicennas) in foetu perit, ut ei mox alia sufficiatur vegetior: sed quasi repuerascens perpetua fit, non secus quàm quae in stirpium seminibus inest. Eadem de sentiente facultate ratio est, quae in foetu redintegrata, interim otio sopitur dum foetus perfectior euadat, tum deinde in actum prodit, suàque depromit opera, his demum mouendi vis appellit. Caeterum princeps pars ea animi, quae mens appellatur, et rationis praestantia excellit, separabilis quum sit à corpore, nequaquam in materia potestate continebatur, ex qua demum temporis progressu erumperet. Alioqui enim immersa corpori, ipsiusque egens perpetuò, nec ratiocinari, nec intelligere, nec aliud quicquam citra organum corporeum posset efficere. Ab summo rerum autem conditore primum creata, in praeparatum instructumque infantis corpus vniuersum, temporis momento commi-[P174] grat, idque mense quarto fieri proditum est, quo tempore cor et cerebrum consummata iam sunt. Caeterum humoris redundantia, veluti in ebrietate, aut lethargo sopita, nondum potest quae sua sunt munera proferre. Si animus ille in quo inesse quiddam coeleste et diuinum doctissimi illi veteres putauerunt, potestate nequaquam inhaerebat in seminis materia, quid causae est cur non similiter ut hominum sic etiam equorum, canum, brutorumque caeterorum foetibus accedit? Quoniam sic summus ille rerum omnium conditor singulari sua erga hominum genus bonitate contulit. Veruntamen si naturae rationem penitus introspicimus, luculenter profectò deprehendemus, in humano foetu quandam corporis praeparationem, partium temperaturam et compositionem à vi effectrice

from material, it never arrived through divine intervention, nor from any other outside source. In every kind ["*genere*"] of living creature, the male contributes the exceptional substance of semen; surely likewise he contributes also the soul's power at the very beginning, along with spirit. But at the start it lurks in the semen, hidden from the senses, largely undetected during the time when it is said to be present in potentiality. But as time passes, it is roused by the womb's power, and reveals itself by its action; for presently, as soon as the semen is conceived, the fashioning power comes into operation, which some say is a sort of semblance ["*idolum et ideam*"] of the generating power. When it has finished fashioning the whole of the fetus, most people think that it is entirely redundant and vanishes; however, since later on in adults it generates and calls forth teeth, I would think it more accurate that it is stored, with nothing to do because of lack of material. The permanent faculty of nutrition follows on, one that never abandons the animal during life. Derived from a parent, it does not, as Avicenna thought, perish in the fetus when the fetus soon gets another more energetic one; no, renewing its youth, so to speak, it becomes permanent, like the one in plant seeds.

The same account applies to the sentient faculty: revived in the fetus, somnolent at its ease in the meantime until the fetus gets more complete, it then comes into operation and deploys its actions; ultimately the power of moving enters these [actions]. But the main part of the mind ["*animus*"], called the intellect ["*mens*"], is also outstanding in the excellence of reason; since it can be separated from the body, it was not potentially enclosed in the material, to break out from that in the end as time passed. For otherwise, sunk in the body and forever dependent on it, it would be incapable of reasoning, of understanding, or doing anything else without its bodily instrument. Made at the beginning by the supreme creator of things, it [P174] removes in a moment into the whole prepared and equipped body of the infant; this is held to happen in the fourth month, when heart and brain are already brought to completion. But through excess of moistness ["*humor*"], slumbering as though in drunkenness or torpor, it cannot yet deploy the functions it has. If this mind, in which those most learned ancients believed that something divine of heaven resided, was not in potentiality implanted at all in the seminal material, what is to prevent it getting attached to the fetuses of horses, dogs, and other brute creatures, in the same way as to human fetuses? Because the supreme creator of all things bestowed it that way, in his extraordinary goodness towards humankind.

But if we look more closely into nature's system, we shall surely make a splendid discovery: in the human fetus the effective power brings about a

produci, quae vel diuinam illam mentem et ratiocinandi facultatem elicit, vel eam saltem admittit et conseruat, tanquam conuenientem, et cunctis functionibus obeundis consentaneam. Quanquam enim (vt Aristoteles est author) nihil cum eius actione communicat actio corporea, corpore tamen malè affecto, aut non congruenter praemunito, eius actio deprauari percipitur. Hoc itaque successus⁹ ordine animae partes in foetu ex Platonis sententia comparent, qui tres eas situ atque substantia seiugauit. At minimè putes sentiendi anima appellente, altricem perire, et cùm summa illa rationis particeps accesserit, quam omnium vim habere existimant, caeteras intercidere. Illi enim hae semper assident, essentia sedibúsque distinctae. Aristoteles de hoc ipso facultatum ordine inquit, non idem simul animal et hominem fieri: sed prius quidem animal, deinde verò hominem, postea et hunc quoque hominem.¹⁰ Quum in foetu primum simplex et solitaria inerat anima naturalis, frutex is vtique non erat: neque quum sentiens anima accessit, brutum is certè fuit. Non enim quicquid stirpium modo viuit, id pro stirpe ducendum: quoniam iam saepe admonuimus naturalem hanc partem in animantibus quàm in stirpibus quodammodo perfectiorem haberi, et quae semini inest, potestatem in se hanc continere sentiendi: neque quod eandem cum animali vitam agit, animal statim est: neque si animal, continuò brutum aut bos, aut leo, aut canis, aut eorum quiddam quae per se viuere ac sentire conspiciamus. Et quanquam, vt alibi à nobis proditum est, quae in absoluto iam animali sunt animae partes, adeò connexae sunt, vt seiungi aut diuelli nequeant, nec vlla possit occumbere aliis saluis et constantibus, gigni tamen possunt et in actum erumpere, eo quem diximus ordine. Multo enim aliter occumbunt quàm genitae sunt: non enim interitu in semen redeunt, vnde emerserunt. Quare omnium simul facultatum interitus, momento fit. Caeterùm si Aristotelis sententiam institutionémque prosequimur, quae ad veritatem propensior videtur, hae facultates et animae partes, non ex crassa seminis materia prodierunt, sed ex coelesti calore et spiritu, in quo omnem vim et potestatem consistere, à nobis est explicatum. Est enim eo authore in spiritu et calore vis atque facultates nondum reipsa agens, sed potestate: huius autem instrumentum est spiritus, vtriusque verò sedes et materia est seminis pars terrena atque crassa. Haec igitur seminis potestas, et quae in spiritu vis delitescit, tota in foetus facultates conuertitur, spiritus in spiritum, quemadmodum terrena eius materia in solidarum partium, et spermaticarum substantiam facessit.

preparation of the body, and tempering and association of the parts, and it either evokes the divine mind and the faculty of reason, or at least admits it and preserves it as suitably appropriate for the carrying on of all functions. Although, as Aristotle holds, bodily activity has nothing to do with its activity, still, if the body is harmfully affected, or not properly protected, its activity is noticeably impaired. And so the parts of the soul make their appearance in the fetus in this order of succession, according to Plato, who distinguished the three of them in position and substance. But you would hardly suppose that the nourishing soul perishes when pushed by the sentient soul, and that the latter supreme soul cuts off the rest, on its advent with its share of reason and its reputation for holding the power of them all. No, they will always be stationed near it, differing in their essence and their seats. On this very order of the faculties, Aristotle says that the same [entity] does not simultaneously become an animal and a man; first it becomes an animal, then a man, and thereafter this [particular] man too. When the natural soul, simple and on its own, was first present in the fetus, the fetus was at any rate not a bush; and it was certainly not a brute beast when the sentient soul arrived. For everything that leads its life after the fashion of plants is not to be regarded as a plant; we have already often issued a warning that this natural part is in a way more perfect in animals than it is in plants, and the part in the semen possesses in itself this potentiality of sensation. Again, what leads the same life as an animal is not automatically an animal; nor, if it is an animal, is it necessarily a brutish ox, or lion, or dog, or one of the creatures we see living and feeling on their own. As we have indicated elsewhere, the parts of the soul in an animal now complete are so linked that they cannot be separated or parted, and that none of them can pass away with the rest surviving intact. But they can be begotten and burst into activity, in the sequence we stated. Their passing away is quite different from their begetting: on passing away, they do not return into the semen whence they came forth. Consequently the synchronous decease of all the faculties happens in a moment. If, however, we pursue Aristotle's view and teaching, which seems a nearer approach to the truth, these faculties and parts of the soul did not emerge from the thick material of semen, but from celestial heat and spirit, in which, as we have explained, all power and potentiality are present; in his account, a power and faculties exist in spirit and heat that are not yet active in reality, but in potentiality; its [singular] instrument is spirit, and the abode and material of both is the thick and earthy part of semen. This potentiality of semen, then, and the power lurking in spirit, are entirely converted into the faculties of the fetus, and the spirit into spirit, in the way that [semen's] earthy material departs into

Ex his autem intelligi potest, eos aut perperam aut contumeliosè Aristotelis sententiam detorsisse, qui eum dicunt statuisse semen solius opificis, non autem subiectae materiae rationem habere. Saepenumero enim hic seminis appellatione eam facultatem designauit, quae in terrena crassitudine consistit: hanc autem demonstrat constituti foetus partem non fieri, sed opificis vim obtinere. Nec enim mas omnis (inquit) semen emittit, et quibus emittitur maribus, nulla pars foetus hoc est; sicut nec à fabro quicquam secedit ad lignorum materiam.¹¹ Quibus certè nihil aliud inferre conatus est, quàm opificem quatenus opifex est, partem non fieri constituti artificij. At seminis corpus ille foetui pro materia subiecit. Ossa (inquit) in prima constitutione gignuntur ex seminis excremento. Paulò post, Nerui [*sic*] etiam eodem modo quo ossa instituuntur, et ex eodem seminis excremento. Iam verò si maris semen, multo magis foemineum pars fit constituti foetus: ex hoc enim tum membrana allantoides dicta, tum etiam masculi seminis incrementum fit, vnde partium quoque [P175] solidarum materia sufficitur. Vt enim in bicoloribus ouis, animal (inquit Aristoteles) ortus sui materiam à candido sumit, cibum autem à luteo (origo quippe pulli in albumine est, cibus per vmbilicum ex luteo petitur) ambóque à foemina proficiscuntur: quod autem in ouo est maris semen, tepido calore excitatum, pullum constituit fingítque ex candido partes singulas, eas autem alit ex luteo. Ad hunc eundem prope modum, vel eo authore, in mulieribus atque iis animantibus quae viuum partum aedunt, masculum semen ex foemineo auctum solidas partes constituit, quae dein menstruo aluntur. Oui quippe luteum mulieris menstruum, candidum verò terrenae seminis substantiae proportionem respondet. His omnem iam videor hominis ortum atque adeò vniuersam Physiologiam complexus, quae hominis (dum prospera fruitur valetudine) constitutionem naturámque continet. Nunc qui affectus illi praeter naturam obtingere possunt, et quae horum sint causae, proximo deinceps opere narrandum.

LIBRI SEPTIMI PHYSIOLOGIAE, DE HOMINIS PROCREATIONE, FINIS.

1. de gener.
animal. ca. vi.

Lib. 3 cap. [*sic*]

3. de gener.
animal cap. 1.

the substance of the solid and the spermatic parts. From this it is possible to appreciate how Aristotle's view has been bent (either by mistake or insultingly) by those who say that he laid it down that semen has the role ["ratio"] of the craftsman only and not of the supplied material. He did very often describe by the name "semen" the faculty resident in the earthy thickness, and shows that this does not become a part of the established fetus, but possesses the power of the craftsman. Not every male, he says, emits semen, and in the case of those that do, it is no part of the fetus; similarly, nothing departs from the carpenter to the material of the timbers. From this he surely tried simply to put forward that, insofar as a craftsman is a craftsman, he does not become a part of the created artefact. But he did make the body of the semen serve the fetus as material. Bones he says are begotten in the first formation ["constitutio"], out of the semen's refuse. Nerves [he says] are established a little later, in the same way as bones, and from the same refuse [of semen]. Then, if the male's semen is a part of the established fetus, the female's is much more so, and from it are made both the so-called allantoic membrane and an addition to the male semen, out of which the material of the [P175] solid parts is provided too. In the case of bicolored sheep, as Aristotle says, the animal takes the material for its origin from the white, and its nutriment from the yellow (the origin of a chicken is in the egg white, its food is obtained through the navel from the yolk), and both proceed from the female; but the male's semen in the egg, aroused by warmth, establishes the chick, shapes the individual parts out of the [egg] white, and nourishes them from the yolk. In almost this same way, at any rate in Aristotle's account, in the case of women and the animals that bring forth live offspring, it is the male semen, augmented by the female semen, that sets up the solid parts, which are then nourished by the menstrual flow. Egg yolk is the menstrual flow of the woman, and the white corresponds to the earthy substance of semen. With this I think I have covered the whole origin of man, and indeed all of Physiology, which comprises the constitution and nature of man for as long as he enjoys favorable health. Next, I am to describe in the following work the preternatural affections that can impinge on him, and their causes.

NOTES TO THE LATIN

De partium corporis humani descriptione. Liber primus.

1. In margin here: “φύσις γὰρ τοῦ σώματος ἀρχὴ τοῦ ὄν(?)ιατρικῆ λόγου, inquit Hippocrates de locis in homine.”

2. In margin: reference to derivation of ἄνθρωπος from ἄνω τρέπων ὤπα.

3. Clavicles found only in man: see Galen, *On Anatomical Procedures*, Duckworth translation, p. 91, for a statement that pigs have no clavicles. Galen (*On Anatomical Procedures*, Singer translation, pp. 2, 97, and 115) remarks that apes and the dog-faced baboon, like man, possess clavicles. Richard Owen states in volume 2 on various pages of *On the Anatomy of Vertebrates* (3 vols. [London: Longmans Green, 1868]) that broadly speaking, almost all birds, all felines, most carnivores, though not ruminants and rodents and horses, possess clavicles. It is hard to explain the ancient belief.

4. A word not in classical Latin.

5. *De naturali parte medicinae* (1542; hereafter referred to as “1542”) reads “capimus.”

6. Normally five in man, and fewer in many other animals.

7. “Pomegranate,” a synonym for the xiphoid process at the lower end of the sternum. These “iuniores” erred; P. de Koning (1903, cited by O’Malley and Saunders, *Leonardo da Vinci on the Human Body*, p. 86, Plate 23) showed that the Latin translator of Avicenna took his word “khanjara” (= xiphoid, swordlike) as “hanjara” (= larynx, rendered in Latin as “cartilago epiglottalis,” at that time the term for the whole larynx), the difference in Arabic being one dot. The synonym at the time for “epiglottis” was “pomum granatum,” a phrase thus puzzlingly transferred to the xiphoid process. Vesalius did not use this term but mentioned many others: see *De humani corporis Fabrica*, Book 1, Chapter 19, p. 93, and p. 167, legend “P1,2,3.”

8. This word, known to Castelli’s dictionary as a synonym for scapula, is clearly a misreading of “scutula” (little shields) in Celsus, *Medicina*, Book 8, Chapter 1. “Covered little shield” is apt for a scapula.

9. Properly, as Castelli’s dictionary points out, “brachium” should mean either the upper extremity from the humerus down to the hand, or just the upper arm, and βραχίων was so used by Galen, e.g., in *De usu partium*, Book 2, Chapter 2. Vesalius (*De fabrica*, Book 1, Chapter 21, p. 99) remarks that Hippocrates calls humerus βραχίονα and (Chapter 23, p. 105) that what Celsus calls humerus is βραχίωμ [sic] to Greeks and to many Latins. But Vesalius wishes brachium to be the upper arm, and the humerus its bone. Fernel is heterodox here.

10. Galen (Περὶ Ὄστων τοῖς εἰσαγομένοις, Chapter 24, in *Opera Omnia*, vol. 2, p. 775) uses this term. Vesalius (*De fabrica*, Book 1, p. 145) is very clear: it indicates the

upper part only—"orbiculare ac laeve rotulae illius partis modo"—and is four-sided. Gray's *Anatomy* (p. 410) remarks that "the *body* of the talus is cuboid."

11. Compare Banister's translation: "With flesh that the body ther of might be large, or to confirm and hold together those partes as sayth Fernelius [lib. I cap. 5]" (John Banister, *The historie of man, sucked from the sappe of the most approued Anathomistes, in this present age, compiled in most compendious fourme, and now published in English, for the vtilitie of all godly Chirurgians within this Realme*, London, printed by John Daye, dwellynge over Aldersgate, 1578, F44r. Facsimile as number 122 of *The English Experience: Its Record in Early Printed Books Published in Facsimile* [Amsterdam and New York: Da Capo Press, 1969].)

12. A long established synonym for "muscle," because some muscles resemble lizards.

13. The ring finger. Macrobius (*Saturnalia*, Book 7, Chapter 13) says so ("in digito qui minimo vicinus est, quem etiam medicinalem vocant"), but does not say why.

14. This word means "unfolds," and the meaning is not clear; if the muscle is gracilis, it flexes the knee.

15. Castelli's dictionary equates this to $\pi\epsilon\delta\acute{\iota}\omicron\nu$ and indicates that it means the sole of the foot. But this is not accurate; Galen (*De ossibus ad tirones*, Chapter 25, in *Opera Omnia*, vol. 2, p. 777; *De usu partium*, Book 3, Chapter 5, concurs) defines $\pi\epsilon\delta\acute{\iota}\omicron\nu$ clearly as the metatarsus: the set of five bones leading to the toes and all that goes with them, and not the arch or instep, which is fundamentally a curve. Tallmadge May writes (*De usu partium*, Book 3, Chapter 5, her p. 164 n. 18) that she uses the translation "pedion," because there is no Greek word "metatarsion" to correspond to "metakarpion," and that when in Chapter 8 Galen says the word means the part of the foot in contact with the ground, he is "probably fabricating a false etymology." She cites Markwart Michler, *Sudhoffs Archiv* 48 (1961): 200–15.

16. Banister's translation (note 11, F74v.) runs: "Of this (sayth Fernelius) the dregges, and refuse in the belly have their first kynde and name."

17. The appendix is not mentioned. Vesalius shows it in his *De fabrica*, Book 5, p. 361, fig. 8, which seems to have it perfectly; p. 500, however, gives its name as "caecum," and it is only a "thick worm." The original describer was Berengario da Carpi (1521); Ryff (1541) called it the "additamentum."

18. This word is not classical Latin, but is a conversion of the Greek word into Latin, a so-called "calque" of it.

19. Banister's translation (note 11, F54r) runs: "The midrief called also an ouerthwarte diuision, and a girdle to the body, besides that it is the first instrument of inspiration, it helpeth also very well to the unloadyng of the belly, and driuing out dregges."

20. The reference to Sextus Pompeius Festus (second century a.d.?) is correct: his *De verborum significatu* (J. W. Pirie, W. M. Lindsay, eds., *Glossaria Latina* [Paris: Les belles lettres, 1930] vol. 4, p. 284) uses this rare word to refer to the partition in a walnut.

21. Vesalius (*De fabrica*, Book 5, Chapter 5, p. 503, l. 29) uses the same two terms for the external ear.

22. Banister (note II, F102v) refers to this passage.
23. Banister (note II, F104r) remarks: "Now fo tastyng, whose chieffest instrumentes (sayth *Ioannes Fernelius* in his ix. Chap. De partibus corporis humani) are in the palate and tounge."
24. 1542 offers in addition the synonym ἄζυξ.
25. In Chapter 5, the finger is called "medicinalem."
26. This is probably the thyroid gland. Vesalius (*De fabrica*, Book 6, Chapter 4, p. 574, l. 32) makes more of it, mentioning at the root of the larynx, "glandulosum et rubicans corpus (quod postea expressius . . .)," and on p. 576, l. 51, to "glandulas," fleshy and darkish, with many veins. Thomas Bartholin (*Anatomia reformata* [Copenhagen: Adrian Vlacq, 1655], at Book 2, Chapter II, p. 297) is much clearer on the anatomy and supposes the function is to moisten the larynx.
27. This is the parietal pleura lining the inside of the rib cage, but not lining the mediastinum or the diaphragm. See Galen, *On Anatomical Procedures*, Singer translation, Book 5, Chapter 8, p. 141.
28. In the context this word seems to mean "existence" but is not found in classical Latin or with this meaning in other dictionaries consulted.
29. Vesalius has instructions for a dissection in his *De fabrica*, Book 5, Chapter 19, and the instruments are shown in Book 2, Chap. 7, unnumbered figure on p. 235.
30. It appears from Castelli's dictionary that this word can be used either in the singular or the plural in its anatomical sense.
31. Castelli's dictionary indicates that the word means a razor, as used for shaving hair.

De Elementis. Lib. II.

1. Ablative, evidently.
2. Lucretius, *De rerum natura*, Book 2, pp. 1112–15.
3. *Thesaurus Linguae Latinae*, V.2, p. 404, confirms that the likeness of sound between "eloquium" and "eulogium" created some lability of meaning.

De Temperamentis. Lib. III.

1. Lucretius, *De rerum natura*, Book 2, pp. 340–41.
2. Ibid., Book 4, p. 644.
3. Ibid., Book I, pp. 821–22.
4. Ibid., Book I, 699–700.
5. Ibid., Book 4, pp. 478–79. Marginal "eodem libro" incorrect.
6. Ibid., Book 4, p. 485.
7. Ibid., Book 4, p. 513–17.
8. The Aphorism is in fact number 34 in section 2, not number 25 as stated in Fernel's marginal note here.

De Spiritibus et innato calido. Liber IIII.

1. Robert Stephanus's *Dictionarium Latinogallicum* (Paris: 1544) does not list this word but offers: "Lychnus . . . Chandelle, Lampe ou Luminaire," and "Lychnus ligneolus, une lampe ou lanterne de bois." It must mean "lamp wick," as the Greek ἐλλύχνιον does; compare Jean Riolan the elder's "si olei maiorem copiam in elychnium effunderis, flammam extinxeris." (*Commentarius ad Fernelii librum de functionibus et humoribus*, Chapter 16, p. 95D, in the 1610 edition of his *Opera Omnia*). 1542 uses "lychni" instead, but *Medicina* (hereafter referred to as 1554) uses "elychnij."

2. 1542 and 1554 give instead "resarciuit"; incidentally, "resarcio" (to patch or mend) has no perfect tense according to the *Oxford Latin Dictionary* (OLD); if it had, it would be "resarsit," the reading of the errata.

3. The reference is to Aristotle's treatise *De Longitudine et Brevitate Vitae*, Chapter 5, Bekker 466b1–2.

4. *De re rustica* 12.12.1 and 12.48.3.

5. *Sic*; "similaris" is not OLD, and Castelli gives ὁμοιομερής as its Greek equivalent.

6. Aphorism I.14.

7. I have not traced this statement in the works of Hippocrates.

8. I have not traced this statement in the works of Hippocrates.

9. Robert Stephanus's *Dictionarium latinogallicum* (Paris: 1544) gives for this word "debiliter, errener." The term "delumbo" in OLD means "injure, app. by dislocating the hip or sim.; to bring down on the haunches." Castelli notes the word but is obscure on its meaning.

10. The spelling "demanio" is in OLD, but "dimanio" appears in Robert Stephanus's *Dictionarium sive Latinae linguae Thesaurus*, 2d ed. (Paris: 1544).

11. Aphorism I.15.

12. No appropriate meaning for this word was found in Castelli's dictionary or in Robert Stephanus's *Dictionarium latinogallicum* or his *Thesaurus*—only cardiac meanings, or a mark of punctuation or a general dilatation. A respiratory activity may be meant here.

De animae facultatibus. Lib. V.

1. A capital letter is evidently not obligatory after a question mark.

2. This chapter is not present in Fernel's *De naturali parte medicinae* (1542) but was introduced in his *Medicina* (1554).

3. "Quid vivere" appeared in this title in 1542, in addition to "quid vita," but not in 1554.

4. The word is not classical Greek but is used in Cicero, *Tusculan Disputations* 4.9.21, with the meaning "being angry."

5. *Sic*; but it seems best to read "conditionem," which supposes simply a lost tilde.

De Functionibus et Humoribus. Lib. VI.

1. This word normally means “to purchase food”; its use in the sense of “to victual oneself” does not appear in the dictionaries consulted.
2. The word is also Hippocratic, and Castelli’s dictionary equates it to “elixatio,” the boiling down of a solid mass in water during cookery.
3. Barley (or similar) water, also spelled ptisana; known since the Hippocratic works.
4. This word is not in Castelli’s dictionary (which uses copros and stercus instead), and is an error; the classical form is σκῶρ, genitive σκατός.
5. Castelli’s dictionary describes this as the scrapings of the skin after a bath or exercise, equating it to γλοιός: “sordes, quae in balneis, aut palaestra ab hominum cute deradebatur, multi quondam in Medicina usus. Calefaciunt enim modice, emolliunt, et discutiunt.” As Francis Adams remarks in his translation of Paulus Aegineta (*Paulus Aegineta: The Seven Books* [London: Sydenham Society, 1846], vol. 3, p. 88): “It appears singular that mankind should have so long retained a fancy for such an application, considering how easy it was to find a more agreeable substitute for it.”
6. I have not been able to find this material.
7. In Fernel’s *De naturali parte medicinae* (1542) the title of this chapter is “Non posse facultatis quae ratiocinatur, functiones prorsum laedi, alijs integrè valentibus.”

De hominis procreatione atque de semine. Liber VII.

1. Despite the marginal reference, if Book I of *De generatione* is meant, the correct reference is to Chapter 23, 731a13.
2. Bekker 717a21.
3. Bekker 734b33.
4. This is a puzzling reference. Oribasius wrote no aphorisms, and the Hippocratic Aphorism 23 in Book 6 is not relevant. The Hippocratic Aphorisms are conveniently accessible in *Hippocratic Writings*, trans. J. Chadwick and W. N. Mann (Harmondsworth: Penguin Books, 1978). In Oribasius, *Collectanea medica*, ed. Buscemaker and Daremberg (Paris: Imprimerie impériale, 1858), vol. 3, p. 50, there is a passage on two uterine mouths, but one opens into the vagina and the other(s) are the horns of the uterus, opening onto the ovaries.
5. The tale appears in Pliny the Elder, *Natural History*, trans. W. H. S. Jones (Loeb Classical Library) (London: Heinemann, 1963), XXVIII, 42, 149, but the statement about inhaling the snake is new; Pliny wrote of serpents: “exitio his esse cervos nemo ignorat, vt, si quae sunt, extractos cavernis mandentes.”
6. The normal meaning of this word is “bottom,” but in anatomical practice it seems to correspond to what would be the bottom if the viscus in question were removed and used to contain water. In the case of the bladder this is then the top, and the term is so used by Vesalius (*De fabrica*, Book 5, fig. 2, p. 356) and by modern parlance.

7. The marginal reference is correct: *De usu partium*, Book 15, Chapter 7 (Tallmadge May translation, p. 672).

8. The Stephanus Latino-Gallic dictionary recognizes “aedo” as an alternative spelling of “edo.”

9. “Successio” is the normal word in this sense and means “le fait de succéder à aucun” (Stephanus Latino-Gallic dictionary); “successus” normally means a “success.” Perhaps the compositor substituted the latter to make the line fit better.

10. The marginal reference is correct: Bekker 736b3; but Aristotle did not write the equivalent of the final “hunc hominem.”

11. The correct reference here appears to be *De generatione animalium*, Book 1, Chapter 22, Bekker 730b12–13.

NOTES TO THE TRANSLATION

Introduction

1. Sir Charles Sherrington, *The Endeavour of Jean Fernel* (Cambridge: Cambridge University Press, 1946; reprint, Folkestone and London: Dawsons of Pall Mall, 1974). Sherrington himself notes the fact that the great eighteenth-century Dutch physician Hermann Boerhaave (1668–1738) dismissed Fernel's *Physiologia* with the remark that "nothing prior to Harvey is any longer of use" (p. 183). On the importance of Vesalius see, for example, Charles D. O'Malley, *Andreas Vesalius of Brussels, 1514–1564* (Berkeley: University of California Press, 1964). Literature on Paracelsus and his influence is vast. See, for example, Walter Pagel, *Paracelsus: An Introduction to the Philosophical Medicine of the Era of the Renaissance* (Basel: S. Karger, 1958), and A. G. Debus, *The Chemical Philosophy: Paracelsian Science and Medicine in the Sixteenth and Seventeenth Centuries*, 2 vols. (New York: Science History Publications, 1977).

2. Sherrington, *Endeavour*, p. 101.

3. But Antonio Benivieni's pathology was founded on 111 cases. See Antonio Benivieni, *De abditis nonnullis ac mirandis morborum et sanationum causis* (1507), translated by Charles Singer (Springfield, Ill.: C. C. Thomas, 1954). Far more—over five thousand—are included in Theophilus Bonetus, *Sepulchretum sive anatomia practica ex cadaveribus morbo denatis* (Geneva: Leonard Chouët, 1679).

4. Sherrington, *Endeavour*, p. 74. For the more historically correct account see Jerome J. Bylebyl, "Disputation and Description in the Renaissance Pulse Controversy," in Andrew Wear, R. K. French, and I. M. Lonie, eds., *The Medical Renaissance of the Sixteenth Century* (Cambridge: Cambridge University Press, 1985), pp. 223–45.

5. Sherrington, *Endeavour*, p. 63, referring to Fernel's *Physiologia*, Book 6, Chapter 13.

6. Sherrington, *Endeavour*, p. 70, referring to *Physiologia*, Book 6, Chapter 1. Consider Galen, *On the Natural Faculties*, trans. Arthur John Brock (London and New York: Heinemann and G. P. Putnam's Sons, 1916), p. 97: "For is it not indicative of attraction that always when the lower parts of the gullet dilate the upper parts contract?" Knowledge of the phenomenon in the gullet was clearly Galenic or pre-Galenic. Sherrington does not mention *On the Natural Faculties*.

7. Andreas Vesalius, *De humani corporis fabrica* (Brussels: Culture et civilisation, 1964), Book 5, p. 396: the "stomachus" (his word for the esophagus) "quasi detrusum cibum suscipiens illum deorsum pellit, partibus ipsius quae sunt infra quod deoratur dilatatis, quae vero supra contractis."

8. Sherrington, *Endeavour*, pp. 20–21. Whether this shows Fernel was ahead of

his time or not, the unembarrassed endorsement of eugenics marks Sherrington himself out as very much a man of his own time.

9. Sherrington, *Endeavour*, p. 139.

10. *Ibid.*, p. 145. For his full discussion of astrology and magic, and their supposed rejection by Fernel, see pp. 22–41 and 41–52.

11. According to Roger Smith, Sherrington used his study of Fernel as “an expression of the values which he [Sherrington] located in the life of science.” It was important for Sherrington to show Fernel as one who was able to go beyond his Galenic culture by “observation and experience.” See Roger Smith, “The Embodiment of Value: C. S. Sherrington and the Cultivation of Science,” *British Journal for the History of Science* 33 (2000): 283–311, p. 310. We are grateful to Dr. Smith for allowing us to consult this paper before publication. For indications of the negative attitude to the role of magic in the history of science typical of Sherrington’s circle in Cambridge, see Brian Vickers’s introduction in *idem*, ed., *Occult and Scientific Mentalities in the Renaissance* (Cambridge: Cambridge University Press, 1984), 1–55, pp. 1–2. Research on Plancy and his biography of Fernel remains a desideratum, but for a discussion of increasing identification between Fernel and Paracelsianism in the late sixteenth century see Laurence Brockliss and Colin Jones, *The Medical World of Early Modern France* (Oxford: Clarendon Press, 1997), pp. 133–35.

12. For recent studies of magic and its role in the development of modern science, consider Stuart Clark, *Thinking with Demons: The Idea of Witchcraft in Early Modern Europe* (Oxford: Clarendon Press, 1997), Part II, pp. 151–311; Brian Copenhaver, “Astrology and Magic,” in C. B. Schmitt and Q. Skinner, eds., *The Cambridge History of Renaissance Philosophy* (Cambridge: Cambridge University Press, 1988), pp. 264–300; *idem*, “Did Science Have a Renaissance?” *Isis* 83 (1992): 387–407; William Eamon, *Science and the Secrets of Nature: Books of Secrets in Medieval and Early Modern Culture* (Princeton: Princeton University Press, 1994); John Henry, “Occult Qualities and the Experimental Philosophy: Active Principles in Pre-Newtonian Matter Theory,” *History of Science* 24 (1986): 335–81; *idem*, “Magic and Science in the Sixteenth and Seventeenth Centuries,” in R. C. Olby et al., eds., *Companion to the History of Modern Science* (London: Routledge, 1990), pp. 583–96; Keith Hutchison, “What Happened to Occult Qualities in the Scientific Revolution?” *Isis* 73 (1982): 233–53; Ron Millen, “The Manifestation of Occult Qualities in the Scientific Revolution,” in M. J. Osler and P. L. Farber, eds., *Religion, Science and Worldview: Essays in Honor of Richard S. Westfall* (Cambridge: Cambridge University Press, 1985), pp. 185–216; and Charles Webster, *From Paracelsus to Newton: Magic and the Making of Modern Science* (Cambridge: Cambridge University Press, 1982). All of the recent studies on Fernel listed in the following note pay due acknowledgment to Fernel’s occultism and its positive role in his work. Sherrington discusses the *De abditis rerum causis*, which he falsely assumes Fernel must have later repudiated, in his *Endeavour*, pp. 42–53. He discusses amulets on pp. 42–43, but see also Brockliss and Jones, *Medical World*, pp. 132–33.

13. D. P. Walker, “The Astral Body in Renaissance Medicine,” *Journal of the Warburg and Courtauld Institutes* 21 (1958): 119–33; Thomas S. Hall, *Ideas of Life and Matter: Studies in the History of General Physiology 600 B.C.–1900 A.D.*, 2 vols. (Chicago:

University of Chicago Press, 1969), vol. 1, pp. 188–205; James J. Bono, *The Word of God and the Languages of Man: Interpreting Nature in Early Modern Science and Medicine. Volume 1: Ficino to Descartes* (Madison: University of Wisconsin Press, 1995), pp. 85–122; Linda Deer Richardson, “The Generation of Disease: Occult Causes and Diseases of the Total Substance,” in Wear, French, and Lonie, eds., *Medical Renaissance*, pp. 175–94; Brockliss and Jones, *Medical World*, pp. 128–38; Nancy Siraisi, *The Clock and the Mirror: Girolamo Cardano and Renaissance Medicine* (Princeton: Princeton University Press, 1997), pp. 158–61; Copenhaver, “Astrology and Magic.” There are also two important doctoral dissertations: Linda Allen Deer, “Academic Theories of Generation in the Renaissance: The Contemporaries and Successors of Jean Fernel (1497–1558),” Ph.D. dissertation, University of London, 1980; and James J. Bono, “The Languages of Life: Jean Fernel (1497–1558) and *Spiritus* in Pre-Harveian Bio-Medical Thought,” Ph.D. dissertation, Harvard University, 1981.

14. Galen, *On the Usefulness of the Parts of the Body*, *Περὶ Χρείας Μορίων*, trans. Margaret Tallmadge May (Ithaca: Cornell University Press, 1968); Galen, *On the Natural Faculties*.

15. See Nancy Siraisi, “The Changing Fortunes of a Traditional Text: Goals and Strategies in Sixteenth-Century Latin Editions of the *Canon* of Avicenna,” in Wear, French, and Lonie, eds., *Medical Renaissance*, pp. 16–41; idem, “Medicine, Physiology and Anatomy in Early Sixteenth-Century Critiques of the Arts and Sciences,” in J. Henry and S. Hutton, eds., *New Perspectives on Renaissance Thought* (London: Duckworth, 1990), pp. 214–29.

16. For the historical background to these developments see, for example, Andrew Cunningham, *The Anatomical Renaissance: The Resurrection of the Anatomical Projects of the Ancients* (Aldershot: Scolar Press, 1997); Roger French, *William Harvey's Natural Philosophy* (Cambridge: Cambridge University Press, 1994); G. Whitteridge, *William Harvey and the Circulation of the Blood* (London: Macdonald, 1971).

17. This can be seen most clearly, for example, in Harvey's studies of procreation in his *Exercitationes anatomicae de generatione animalium* (London, 1651); and in Thomas Willis's attempts to understand the nature of the animal soul in his *De anima brutorum* (London, 1672). Other indications of the influence of Fernel are the profusion of editions of his work (see the bibliography in Sherrington, *Endeavour*, pp. 187–207), their widespread diffusion (according to Françoise Lehoux, *Le cadre de la vie des médecins parisiens aux XVIe et XVIIe siècles* [Paris: A & J. Picard, 1976], Fernel was the most popular modern author, after Girolamo Cardano, in the known libraries of Parisian physicians of the period), and the fact that he inspired a number of commentaries on his works by the leading physician, Jean Riolan the Elder (1538–1605) (listed in Sherrington, *Endeavour*, p. 179).

18. Fernel's priority in introducing this use of the word is spelt out by K. E. Roths Schuh, “Der Begriff der ‘Physiologie’ und sein Bedeutungswandel in der Geschichte der Wissenschaft,” *Archives Internationales d'Histoire des Sciences* 10 (1957): 219–25.

19. The more traditional use of the word has recently been used to excellent effect in Dennis Des Chene, *Physiologia: Natural Philosophy in Late Aristotelian and Cartesian*

Thought (Ithaca: Cornell University Press, 1996). The word “physician” is also related to *physiologia*, but far pre-dates Fernel’s usage of the term. The point was that university-trained medical men wanted to imply that they were knowledgeable about nature in general. See J. Henry, “Doctors and Healers: Popular Culture and the Medical Profession,” in Stephen Pumfrey, Paolo Rossi, and Maurice Slawinski, eds., *Science, Culture and Popular Belief in Renaissance Europe* (Manchester: Manchester University Press, 1991), pp. 191–221, 194.

20. Sig. ē4v.: “Quocirca totius medicinae partes quinque si ordine collocabuntur, omnium prima existet φυσιολογική, quae hominis integrè sani naturam, omnes illius vires functionesque persequitur.”

21. As translated in the present volume.

22. On the Renaissance revival of Aristotelianism see C. B. Schmitt, *Aristotle and the Renaissance* (Cambridge: Harvard University Press, 1983), and Brian P. Copenhaver and C. B. Schmitt, *Renaissance Philosophy* (Oxford: Oxford University Press, 1992), pp. 60–126.

23. Book 7, Chapter 6, and Book 5, Chapter 12, respectively. For a full account of the differences between Galenic and Aristotelian theories of procreation see Thomas Laqueur, *Making Sex: Body and Gender from the Greeks to Freud* (Cambridge: Harvard University Press, 1990).

24. Book 3, Chapter 7. For a further example see also Chapter 10 for the argument about changes in temperament with age.

25. Book 4, Chapters 2, 3, 4, and 6.

26. The best accounts so far of Fernel’s notion of the soul and its parts and faculties, spirits, and different forms of heat are to be found in Walker, “Astral Body in Renaissance Medicine,” Hall, *Ideas of Life and Matter*, and Bono, *Word of God*.

27. For a full discussion of Fernel’s theory of spirit, including the critical response, see D. P. Walker, “Astral Body in Renaissance Medicine”; Harvey is discussed on pp. 130–31. Harvey’s critique is also fully considered in Bono, *Word of God*, pp. 103–22. For an account of similar views to Fernel’s see also D. P. Walker, “Medical Spirits in Philosophy and Theology from Ficino to Newton,” in idem, *Music, Spirit and Language in the Renaissance* (London: Variorum, 1985).

28. The innovatory aspects of Fernel’s medical philosophy, and its links to Platonism, are especially brought out in the studies by Brockliss and Jones (see note 11) and those by Bono, Copenhaver, Deer Richardson, Hall, Siraisi and Walker (see note 13). For a full consideration of Fernel as a would-be reformer of medicine see Bono, *Word of God*, pp. 92–97, and idem, “Languages of Life.”

29. See Sherrington, *Endeavour*, p. 59; Brockliss and Jones, *Medical World*, p. 135. Still the standard work on Patin in English is Francis R. Packard, *Guy Patin and the Medical Profession in Paris in the Seventeenth Century* (New York: Paul B. Hoeber, 1924; reprint, New York: Augustus M. Kelley, 1970).

30. Siraisi, *The Clock and the Mirror*, p. 12. Similarly, Thomas Hall calls his chapter on Fernel “Neotraditional Physiology” (*Ideas of Life and Matter*, vol. 1, p. 188). For details of Fernel’s life see Sherrington, *Endeavour*, pp. 147–70, which includes a translation of the early biographical sketch of Fernel by his follower, Guillaume Plancy.

31. Jean Fernel, *De naturali parte medicinae libri septem* (Paris, 1542).
32. Jean Fernel, *Medicina* (Paris, 1554).
33. Jean Fernel, *Universa medicina, tribus et viginti libris absoluta* (Paris, 1567). Jean Fernel, *De abditis rerum causis libri II* (Paris, 1548).
34. Jean Fernel, *Les VII livres de la Physiologie composez en Latin . . .*, trans. Charles de Saint Germain (Paris, 1655). Reprinted in the series *Corpus des Oeuvres de Philosophie en Langue Française* with review of the text by José Kany-Turpin (Paris, 2001).
35. The phrase “copia rerum ac verborum” dates back to Quintilian (*Institutio oratoria*, 10.1.6). King (p. 9; see note 36 below) suggests that it covers variation of a single expression or thought by use of different forms of speech as well as abundance, eloquence, and the ability to vary or enrich language.
36. Erasmus, *Collected Works*, vol. 24: *Literary and Educational Writings 2, De Copia*, ed. Betty I. Knott (Toronto: University of Toronto Press, 1978), p. 321. The work, first published in 1512, was translated by Donald B. King and H. David Rix (Milwaukee: Marquette University Press, 1963).
37. Bartholomaeus Castellus, *Lexicon medicum* (Padua, 1721).
38. Robert Stephanus, *Dictionarium Latinogallicum thesauro nostro ita ex adverso respondens* (Paris, 1544).
39. J. D. Boyd and W. J. Hamilton, “Foetus—or Fetus?” *British Medical Journal* 1 (1967): 425. J.-P. Migne, ed., *Patrologia Latina* (Paris, 1878), vol. 82, part 3, item 144, p. 414.
40. Nancy G. Siraisi, *Medieval and Early Renaissance Medicine: An Introduction to Knowledge and Practice* (Chicago: University of Chicago Press, 1990), pp. 102 ff.

Book 1: Description of the Parts of the Human Body

1. Galen (*De usu partium*, Book 1, Chapter 2; Tallmadge May translation, p. 68) has a famous passage in praise of the hand, which relies much on Aristotle, *De Partibus Animalium* IV. 10. 687a5 ff.
2. The three are evidently a big brain, hands, and clavicles.
3. An alternative word for muscles is also supplied: “lacerti” (little lizards).
4. Like a crown; modern “coronal.”
5. The front half of the skull, contrasted with the occiput at the back.
6. In fact by the lambdoid suture and by junctions with the temporal bones on each side, but at birth not all the bone is ossified, and the back part might appear triangular.
7. The sockets are in fact in the first (atlas) vertebra, and prominent condyles on the occipital bone fit into them. Both Galen and Vesalius described them.
8. Berengario da Carpi is credited with discovering these ossicles in 1522. See Charles D. O'Malley and Edwin Clarke, “The Discovery of the Auditory Ossicles,” *Bulletin of the History of Medicine* 35 (1961): 419–41.
9. The rete mirabile is the division of the internal carotid artery entering the brain into numerous tiny branches that are surrounded by venous channels. It is present in

various animals, but not in man. But clearly Fernel was unaware of its absence in man, which had only recently been discovered. An account of the long history of thought on this organ has been published (John M. Forrester, "The Marvellous Network and the History of Enquiry into its Function," *Journal of the History of Medicine and Allied Sciences* 57 [2002]: 198–217). Its function in regulating brain temperature was only discerned in the 1960s.

10. The "petrous temporal" of today; named "lithoid" above.
11. The greater canthus of Fernel is the medial—"maiorem"—canthus of today.
12. It is not evident what this bone is—possibly an inconstant upper part of the zygomatic.
13. Apparently the roof of the maxillary antrum, and if so a part of the maxilla.
14. Probably the lacrimal bone.
15. Vesalius (*De humani corporis fabrica*, Book 1, Chapter 6; Richardson translation, p. 74) points out that its surface is imperforate and therefore it could not transmit phlegm, as Galen had supposed in regarding it as a sponge.
16. A Latin grammarian and philosopher at approximately a.d. 400.
17. This interstitium is the vomer bone.
18. Vesalius (*De fabrica*, Book 1, Chapter 10; Richardson translation, p. 107) points out that the adult human jaw is a single bone, though twin in certain animals, and there is no such bond.
19. One canine; the second is presumably what we call the first premolar.
20. So says Vesalius too: *De fabrica*, Book 1, Chapter 19; Richardson translation, p. 209.
21. Except in fact the clavicle and humerus.
22. Because as Fernel stated previously, only man possesses collarbones.
23. Vesalius (*De fabrica*, Book 1, p. 92) supplies the meaning of the word "iugulum": the notch at the top of the manubrium sterni. Fernel is clearly much less precise here, and so I translate as "top of the chest bone." Even then, there is immediate uncertainty whether this includes the collarbones or not.
24. Small vascular channels enter the clavicles, but unlike all the other long bones they have small cavities at the ends only, so this statement is puzzling.
25. The tendon is that of the biceps muscle.
26. These cavities must be the olecranon fossa, the larger one at the back of the humerus, and the coronoid fossa, the smaller one at the front.
27. The scaphoid may be regarded as waisted.
28. It is not obvious what is meant; the hipbone of each side comprises three parts united by cartilage in youth, but by bone in the adult. In addition, Fernel's account is confused by his use of singular and plural here.
29. Probably meaning that the bones below it in the shin are twin, like those in the forearm.
30. Vesalius's usual word for this bone (*De fabrica*, Book 1, Chapter 31; Richardson translation, p. 327 ff.). I use it in translation from here on.
31. This phrase is somewhat obscure; I cannot trace any reference to the os calcis as

an “alternative foundation” in Vesalius (*De fabrica*, Book 1, Chapter 33, pp. 146–47) or in Galen (*De usu partium*, Tallmadge May translation).

32. A word still evidently including notions of ligament as well as of nerve in the more modern sense.

33. Such ligaments are not now recognized.

34. If this is the *ligamentum nuchae*, it should end higher up, at the seventh cervical vertebra.

35. This was Francis the Dauphin, son of Francis I, whose unlucky squire was believed to have poisoned him in 1536; the tale is in Francis Hackett, *Francis I* (London: Heinemann, 1934), p. 437. Ganelon too in the “Chanson de Roland” was executed thus (Dorothy L. Sayers, trans. [Harmondsworth: Penguin, 1957], stanza 289), and as late as 1757 at Paris, Damiens suffered similarly for attempted regicide (Norman Davies, *History of Europe* [Oxford: Oxford University Press, 1996], p. 543).

36. Vesalius (*De fabrica*, Book 1, Chapter 2) contends that muscle cannot be a mixture of ligament and nerve.

37. In “*os clauditur animalis*,” the significance of “*animalis*”—a word that can be applied to man—is not evident.

38. Evidently the medial pterygoid, which assists in closing the jaw.

39. This must be *genioglossus*, which does not start from the hyoid but from the inside of the jaw. Vesalius (*De fabrica*, Book 2, Chapter 19, p. 253) numbers it ninth muscle, and he too regards it as unpaired.

40. Probably not its motor nerve in the modern sense but its tendinous component.

41. Presumably this is *serratus anterior*, although the three divisions are not now recognized and the attachment is to the medial border of the scapula, not its “lower parts.”

42. Presumably these are “*levator costarum*,” now reckoned as twelve on each side.

43. No human muscle now recognized seems to fit this description well.

44. Elastic Latin syntax; *trapezius* and perhaps *levator scapulae* are meant.

45. In fact, if this is the “short head,” it originates from the coracoid process of the scapula, but close to the clavicle.

46. More precisely: the long head originates at the top of the glenoid cavity.

47. Evidently *brachialis*, which is inserted into the ulna, but in fact it lies deep to *biceps*.

48. *Triceps*, presumably, counted as two muscles.

49. *Pronator teres* seems the only muscle fitting this description.

50. Galen provides a much more credible account of the sources and nature of supination and pronation in his *On Anatomical Procedures*, Book 1, Chapter 8 (Singer’s translation, p. 22).

51. Evidently *extensor digiti minimi*, which is not normally linked to the ring finger.

52. Galen too mentions a set of seven muscles (*On Anatomical Procedures*, Singer translation, p. 24), but his are clearly identifiable as *lumbricals* and *contrahentes*.

53. Probably adductor pollicis, but the description is at variance with the greater detail of present-day anatomy.

54. This conforms pretty well to Galen, though not to current descriptions: Singer's translation of *On Anatomical Procedures* provides details (p. 143).

55. Neither Galen nor present-day anatomy describe any muscle of this kind; the nearest possibility is *psoas minor*.

56. "aduersi lateris": in fact the attachment is to the ribs of the same side, not of the opposite side.

57. They can in part be described as joining each other at the midline.

58. Possibly *gluteus maximus*, but the insertion is not as described.

59. Possibly *gluteus medius*.

60. Possibly *gluteus minimus*.

61. If the identifications are correct, the last two muscles in fact abduct the thigh and rotate it medially.

62. This should probably be *gluteus maximus*, but the description here does not fit any muscle very well.

63. The only muscle inserted there is *psoas major*, but the rest of the description does not fit.

64. *Semimembranosus* and *semitendinosus* are presumably two of them.

65. One of these two is probably the tendon of *tibialis anterior*, which ends not in the big toe but under the forefoot.

66. It is not clear which this is.

67. This can be achieved by counting *tibialis anterior*, *extensor hallucis longus*, four tendons of *extensor digitorum longus*, and *peroneus tertius*.

68. It does not extend into the sole in man, but does in the ape, and thus Galen held that it did in man.

69. Reading "Lien quidem id deducit."

70. Still called "cardia."

71. The word is "fibras"; in addition to fibers, it can refer to *lobes* of both liver and lung, as its use in Chapter 7 makes clear, and had done so since the time of Celsus and Pliny.

72. "subter": Fernel sees the body recumbent, we see it as erect.

73. "fundus": but today's gastric fundus is its upper part.

74. Galen distinguished two kinds of glands: those such as the pancreas and thymus and mesenteric glands, which merely support vessel branches (*De usu partium*, Tallmadge May translation, pp. 243 and 683; original Book 4, Chapter 20, and Book 16, Chapter 2), and those such as seminal vesicles and salivary and intestinal glands, which produce a moistening humor for their vicinity (e.g., *ibid.*, Book 14, Chapter 11, p. 644). For the mesenteric glands, Fernel here presents both functions.

75. Celsus too used Fernel's word "fibras" for the hepatic lobes.

76. Present-day anatomy describes it as "imperfectly divided into a large right and a much smaller left lobe." Galen had relied on the evidence of animal livers that were multilobate.

77. Galen said this was so (*On Anatomical Procedures*, Book 6, Chapter 13) “in all animals,” but it is not usually true of man. Tallmadge May’s note on *De usu partium*, Book 5, Chapter 5, p. 256, cites an authority on rhesus monkey anatomy who states that in the rhesus monkey, the left kidney lies much lower than the right.

78. A derivation of κενέωνες, “loins,” from κενός, “empty.”

79. I do not understand this simile.

80. That is, it squeezes out or milks out the urine.

81. They are certainly septate, which does not seem to mean the same as “cavernous.”

82. Apparently the testicular veins.

83. This is not true; both originate from the aorta. Vesalius (*De fabrica*, Book 5, Chapter 13, pp. 522–23, and Book 5, figs. 22, 23, 25) shows and describes this correctly, but also derides Galen as a “dreaming Prometheus” for getting it wrong, which he did not. See Περί φλεβῶν καὶ ἀρτηριῶν ἀνατομῆς, Chapter 8, in his *Opera Omnia*, vol. 2, p. 809.

84. A[d]-stites is a Latin transcription, a so-called “calque,” of the Greek παραστάται.

85. Galen’s much clearer and more accurate account is in his *On Anatomical Procedures*, Book 12, Chapters 7–8, but these later books were not available to Fernel, nor indeed to Western Europe generally, until the nineteenth century (Galen, *On Anatomical Procedures*, Duckworth translation, p. xii).

86. The identity of the structure so named was still not agreed universally at the time of the 1746 edition of Castelli’s dictionary: prostate (a word clearly derived from παραστάται), seminal vesicle, or something else? See also original text, Chapter 16, bottom of p. 167.

87. Fernel appears here to identify erroneously the testicular veins as “seminal ducts” and the vasa deferentia as “ejaculatory parastatai.”

88. Galen (*On Anatomical Procedures*, Duckworth translation, p. 130; original Book 12, Chapter 8) refers to no such hole; he describes there membranes derived from the peritoneum sheathing the inguinal vessels.

89. Rupture containing bowel.

90. Rupture containing omentum.

91. Translating “vterum gestauerunt” as “in vtero gestauerunt.”

92. The same word is used of cuplike joint recesses such as that of the hip joint (Chapter 3).

93. If this is the coronary sinus, the “right chamber of the heart” must be the right ventricle and cannot include the right atrium. Galen mentions it (*On Anatomical Procedures*, Duckworth translation, p. 156) but does not specify the site of its link to the heart except that it is on the right side of the heart.

94. The discrepancy between the thickness of the pulmonary and “systemic” main vessels worried Galen much more than it does Fernel: for Galen’s elaborate explanation see *De usu partium*, Tallmadge May translation, pp. 309–19; original Book 6, Chapters 13–15.

95. It is not obvious how to interpret this sentence.
96. Grammatically these must be the aortic and pulmonary valves.
97. The so-called “rough arteries.”
98. The “smooth (vessels), which we call venous.”
99. Present-day anatomy does not appear to recognize any complete rings, except in the case of the cricoid cartilage at the top of the trachea.
100. The pulley simile is used in relation to the recurrent nerve by Galen: see *On Anatomical Procedures*, Duckworth translation, top of p. 87. And there is a much more elaborate presentation in Galen’s *De usu partium*, Book 7, Chapter 14 (Tallmadge May translation, pp. 361–69). Fernel has just above reproduced the Galenic argument (Book 16, Chapter 4, p. 690) that because the relevant laryngeal muscles pull their relatively mobile upper ends downward, “it was of course necessary to send nerves into them from below.”
101. The present-day infundibulum is a solid part surrounding the cavity here so named.
102. As described earlier: i.e., the bottom of the third ventricle.
103. Galen mentions passing a bristle into a central canal in the optic nerve: *On Anatomical Procedures*, Duckworth translation, p. 187; original Book 14, Chapter 2.
104. This must presumably be one nerve, since *pars* is feminine and *unicus* is masculine.
105. Presumably a reference to food returning into the nose.
106. For instance in Galen’s *De usu partium*, Book 10, Chapter 1.
107. This is approximately the conjunctiva.
108. Galen thought that the cerebral pneuma (i.e., spiritus) emerged from the eye and then, after contact with the lit object, returned on the same path through the eye to the brain. This is not exactly what Fernel is saying. See R. E. Siegel, “Principles and Contradictions of Galen’s Doctrine of Vision,” *Sudhoffs Archiv* 54 (1970): 261–76. And for a full detailed account of this view, see Otto-Joachim Grüsser, “On the History of the Ideas of Efference Copy and Reafference,” in Claude Debru, ed., *Essays in the History of the Psychological Sciences* (Clio Medica 33) (Amsterdam-Atlanta, Ga.: Rodopi, 1993), pp. 35–56.
109. The notion that sensory nerves are soft and motor nerves hard is propounded by Galen, for example, in *De usu partium* (Tallmadge May translation, pp. 396–99; original Book 8, Chapters 5–6).
110. This is not the case, but the nervous plexus is complicated.
111. This is the ulnar nerve, passing behind the medial epicondyle.
112. I.e., the duodenum. See Galen, *De usu partium*, Tallmadge May translation, pp. 247–50 (original Book 5, Chapter 3): *πρῶτον μὲν τὴν ἐκφύσιν, δεύτερον δὲ τὴν νῆστιν*. See also *On Anatomical Procedures*, Singer translation, p. 159.
113. This is difficult to interpret; possibly these two streams were really arteries.
114. See note 23 above.
115. Fernel appears to err here. The frontal, not the occipital, pole of the skull was traditionally known as the poop (*puppis*, *πρύμνα*), and the other pole as the prow (*prora*, *πρῶρα*). This is made clear by Vesalius (*De fabrica*, legend on p. 166 of Book 1).

116. Fernel has not in fact named this site previously. It means a trough in which grapes could be trodden out to make juice for wine, and the name is still used by anatomists for this site.

117. "brachium": for the ambiguous meaning of this word, either whole upper limb or forearm, see Chapter 3 above: "Nunc de toto brachio. Sunt omnes eius partes numero tres, humerus, brachium, et manus." See also Book 1, note 9, of the Latin text in the present work.

118. Galen's *On Anatomical Procedures* (Singer translation, pp. 74–77; original Book 3, Chapter 5), should be consulted. Singer remarks (p. 76) that he is not going to translate five of Galen's pages because these veins vary a lot.

119. On original page 38 he has said that "nonnulli" use the term.

120. This seems likely to be the thyroid gland. It is probably what Vesalius saw (*De fabrica*, p. 574, l. 32): at root of larynx "glandulosum et rubicans corpus (quod postea expressius . . .)"; and then on p. 576, l. 51, "glandulas," fleshy but "nigricantes," many veins. Even Castelli's dictionary is not forthcoming about the gland, referring to it as twin glands at the lower laryngeal region.

121. The arterial anatomy in this whole passage is incorrect in detail.

122. "contextum admirabilem": see Book 1, Chapter 3, note 9.

123. This is incorrect. See note 83 above.

124. "Incubaret" can hardly mean "lies on," since the reverse is in fact the case.

125. Galen's term for the parietal pleura: see *On Anatomical Procedures*, Singer translation, p. 173.

126. The original meaning of the Greek word "parenchyma."

127. This is stated in Pliny's *Natural History*, Book 11, sec. 212. Richard Owen (*On the Anatomy of Vertebrates*, 3 vols. [London: Longmans Green, 1868] vol. 3, p. 784) says that horse, carnivore, and pig fat are termed "lard," while ruminant fat is "suet or tallow." Any difference in the two consistencies of fat might now be accounted for in terms of the differing fatty acids present in the different diets.

128. Aristotle, Averroes, and Fallopius did, however, so reckon them; see J. M. Forrester, "The Homoeomerous Parts and Their Replacement by Bichat's Tissues," *Medical History* 38 (1994): 444–58.

129. Reference to Celsus (*Medicina*, Spencer translation, Book 8, Chapter 3, sec. 1, p. 497) shows that the "modiolus" was substantially the same as a modern carpenter's hole-saw, and there was also a larger instrument ("tereбра") for enlarging holes in the head.

130. Not the left ureter; Fernel must mean the left testicular vein, which he has called a "seminal vessel" (original p. 36).

131. See note 86 above.

132. The uterus was a twin organ to Galen: see his *On Anatomical Procedures* (Duckworth translation, p. 112; original Book 12, Chapter 2), and see also the puzzling reference to Oribasius in the present work, Book 7, Chapter 8.

133. For Fernel's imprecise use of "iugulum" see note 23 above.

134. There is in fact no commissure in man. See note 18 above.

135. Thyroid gland? See note 120 above.

136. Medulla cannot here mean the modern medulla oblongata, which is much

below the site of this dissection. But it could certainly mean the white internal matter of the forebrain, in contrast to the gray cortex.

137. The “worm” must surely be the vermis of the cerebellum; it is not evident why Fernel calls it a channel.

138. The first time this term has been used in this work; it may mean to Fernel the tentorial notch.

Book 2: The Elements

1. How a fragment of vein, however small, could still be vein exercised Aristotle and subsequent authorities; see J. M. Forrester, “The Homeomerous Parts and Their Replacement by Bichat’s Tissues,” *Medical History* 38 (1994): 444–58, at p. 445.

2. Gouty deposits or nodules in soft tissue, e.g., under the skin.

3. I have translated “indicio quod” according to the apparent logic, rather than to syntax, which points to the meaning: “which indicates that in the dead they do not always grow.” This is what the same phrase means on the next page.

4. This cryptic clause can be traced to the Hippocratic treatise *The Nature of Man*, probably written by Polybus, a disciple of Hippocrates, and reproduces the words there: εἰ ἐν ᾧν ὄνθρωπος, οὐδέ ποτ’ ἂν ἥλγει. The argument is that pain could not exist in man if he were composed of just one element [Hippocrates, *La nature de l’homme*, ed. and trans. Jacques Jouanna. Corpus med. Graec. I, 1, 3. Berlin: Akad. Verlag, 1975. Section 2, 3; p. 168]. The immediately preceding thought in Fernel here is found in Section 3, 4; page 172. This treatise is also mentioned in the present work, at Book 6, p. 132, and was presumably readily available to Fernel, since the Brentius translation was published around 1490 at Rome and in 1506 at Lyon.

Book 3: The Temperaments

1. On the musical scale; the word is Ciceronian.

2. I.e., probably the highest-pitched with the lowest.

3. Omitting “quam quibus non convenit” as superfluous.

Book 4: The Spirits and the Innate Heat

1. “Planius” is of course an adverb.

2. Philosopher of Caria, fl. ca. a.d. 210, who commented on Aristotle and wrote on the soul and the mind.

3. Syntax unclear.

4. The spirit and the heat together have become singular in number!

5. Literally, “the greatest vigor of age.”

6. Aphorisms section 1, number 15.

7. To translate "indigeo" here as "require" and just above as "lack" seems inevitable.
8. This is the bony substructure, not a part of the brain.
9. The other two times are probably the heating and the incorporation of air.
10. The rete mirabile; see note 9 in Chapter 3 of the translation of Book 1.

Book 5: The Faculties of the Soul

1. "communis sensus": difficult to translate without importing anachronistic mention of "centers."
2. "Galen properly remarks that it is at the same time stomachic and eccoprotic. . . . When washed, it promotes the cicatrization of ulcers." See Francis Adams's commentary on Paulus Aegineta in *Paulus Aegineta: The Seven Books*, vol. 3, p. 34; original Book 7, Chapter 3.
3. Thought to be the offspring of a lion and a panther.
4. The word "faculty" appears to be implied at many points in this passage.
5. The subject of "nequeat" is presumably "accretio."
6. "Animantes," which can mean "alive" or "animal, not plant."
7. "Sese exprimere" does not appear to be classical.
8. Sight, hearing, smelling, tasting, handling.
9. The syntax is precarious and the meaning is unclear, but presumably it means that only touch can have a temperament like what it encounters.
10. If this is not a "wondrously anachronistic rendering," a phrase coined by Professor Vivian Nutton of the University of London in 1983.
11. "fictrix": the distinction from the "facultas quae fingit" just above is not obvious.
12. The turn of phrase is curious. Classically, "versari ob oculos" means "to be before one's eyes"; on this analogy the present phrase means "the faculty is before the phantom, the phantom being a seeing thing."
13. Singer in his translation (*On Anatomical Procedures*, Book 9, Chapter 2, p. 229) equates this to cerebellum, but the spinal cord proceeds from the medulla oblongata. Vesalius (*De fabrica*, Book 7, Chapter 18, p. 653; also fig. 10 in Book 7, p. 615, and fig. 1 in Book 4, p. 331) clearly recommends that his reader actually feel the relations of the medulla and cerebellum: it is Vesalius who seems to have the "manus ocellatae" (hands with little eyes), which Fernel's biographer attributed to Fernel.
14. "in genere": this phrase can surely be interpreted in no other way here or on p. 164, but I cannot find support for this interpretation anywhere in dictionaries and thesauri consulted.
15. "Particulatim" appears here to mean "in detail," but not in classical Latin; the contemporary Latin-French dictionary offers "per parties et parcelles, ou par pieces, par le menu."
16. Castelli interprets "sopor" as loss of sensation and motion, with breathing persisting; deep sleep follows. Response to pinprick remains, but not speech or opening of the eyes.

17. Castelli gives “torpor et oblivio,” and the Latin-French dictionary concurs; I do not translate as “lethargy,” which nowadays implies rather “sloth.”

18. “occasio”: the *Oxford Latin Dictionary* (hereafter *OLD*), Castelli, and the Latin-French dictionary offer only “opportunity”; the translation is based on a guess that “effusio” (a word used once in the present work, in Book 1) might be the author’s intention. Saint-German, who translated the work into French in 1655, made very free with the Latin: “mais si par la moindre petite occasion il s’esleve et il monte aux meninges une humeur ou une vapeur un peu acre, cela cause une tres-sensible.” See Charles de Saint-German, *Les sept livres de la Physiologie composez en Latin par Messire Jean Fernel* (Paris: Jean Guignard, 1655), p. 389.

19. Gweneth Whitteridge (*The Anatomical Lectures of William Harvey* [Edinburgh & London: E & S Livingstone, 1964], p. 328) indicates that Fernel’s argument here, cited by Harvey, is quite new: that sensation derives from the meninges because in disorders they are sensitive to pain, but the brain itself is not.

20. I.e., the spinal cord, and in Book 1, Chapter 10, p. 31, the nerves are described as branches from it as their stem: “Medulla igitur tanquam caudex ramis plurimis fructatur, in omnes artus, sensus, motusque gratia propagatis.” Vesalius (*De fabrica*, Book 3, Chapter 1, p. 316) is very clear on the idea: “Nerve has three components: the central one is like pith of a tree, originates from the brain, and is just like compact brain stuff. The next is like pia mater, and the outer one like dura mater.”

21. Chapter 8 in the current book mentions that the faculty of discriminating and comparing is the principle that establishes the whole kind of animals, including insects.

22. For the meaning of “lethargus,” see note 17 above.

23. “Praecordia” is thus defined in Book 1, Chapter 7, p. 16.

24. This is not in accord with what was said in Book 1, Chapter 11, and not easy to reconcile with normal anatomy. Vesalius (*De fabrica*, Book 6, Chapter 12, p. 590; and see figs. 3 and 5 of Book 6, pp. 561 and 563) is perfectly clear that the origin of the vena cava is at the heart, not at the liver as Fernel, following Galen, holds, and it is large: “totius venae capacitatem amplitudine multum superat.” He continues: “neque, ut quispiam forte arbitraretur, vena cava unico ad hunc modum enata principio, in duos truncos magnae arteriae modo dirimitur” (the vena cava does not divide into two branches near the heart, though the aorta does).

25. I.e., comprises the spinal cord and the nerves, without their meninges or sheaths.

26. The word more exactly is “chylosis”; χύλωσις appears in Galen, *On the Natural Faculties*, trans. Arthur John Brock (London and New York: Heinemann and G. P. Putnam’s Sons, 1916), Book 3, Chapter 4; the Greek text in Galen’s *Opera Omnia* (vol. 2, p. 155) is translated by its editor as “conversio ciborum in cremorem.”

27. Classically the word meant pointing out for praise or blame. The *Linguae Latinae Thesaurus*, vol. 5 (Leipzig: Teubner, 1900–) offers also “id quod probare, affirmare potest”; there is no hint of “hands-on” demonstration.

28. “hoc”: apparently the instrument rather than the role.

29. For rete mirabile, see Book 1, Chapter 3.

30. “quam illi”: “than the parts and the humors,” presumably.

31. Singular, but evidently the spirit and power are referred to.
32. The vital faculty, probably, but the syntax is not luminous.
33. As Book I, Chapter 7, makes clear, this word includes the ovaries.

Book 6: The Functions and Humors

1. The precise meaning is not obvious, but of course human beings cannot breathe and swallow at the same time.
2. "gurgites et voragines": words referring more to gluttony.
3. The syntax indicates that these are probably the medicaments, but is precarious.
4. "Ingurgito" normally refers to liquids rather than to solids.
5. "ventris": usually means one of the great body cavities rather than "stomach," normally "ventriculi."
6. Meaning unclear; possibly the satisfaction derives from the perception "I was empty and now I am full," and there is a special sense that detects either.
7. I have not identified the source of this remark in the Hippocratic Prognosis or Coan Prognosis.
8. Sense unclear; Fernel has not used this word earlier in any sense apparently relevant here.
9. "venter," not "ventriculus."
10. See Book I, Chapter 7: "Two ducts are associated with it to convey the bile: one from the point at which the portal vein runs under the liver, where it attracts the bile into itself, and the other running to where the duodenum ends and the jejunum starts, or in some cases running into the bottom of the stomach, where the overflow of bile is expelled." A further occasional duct is also mentioned, running to the stomach.
11. Actuarius was a thirteenth-century Byzantine medical writer, the last such (Benjamin Lee Gordon, *Medieval and Renaissance Medicine* [London: Peter Owen, 1959], pp. 65–68). He was the author of books on the urine and other topics (*Biographisches Lexikon der hervorragenden Ärzte aller Zeiten und Völker*, 5 vols. [Berlin and Vienna: Urban and Schwarzenberg, 1929–34]).
12. The "snot" of *OLD* would no doubt be more accurate.
13. Paulus Aegineta gives a recipe for ptisan of barley ("barley water"), and other cereals could be substituted. See *Paulus Aegineta: The Seven Books*, Adams translation, vol. 1, p. 120; original Book I, sec. 78.
14. Syntax and meaning unclear; the word chyme was causing ambiguity even in Galen's time, and he remarks (*De simplicium medicamentorum temperamentis ac facultatibus*, Book I, sec. 38, in *Opera Omnia*, vol. II, pp. 449–599) that followers of Theophrastus, Aristotle, and Mnesitheus called the power of taste (which includes the tastes themselves) chyme, and the combination, out of moist and dry, of things digested by heat, chyle; he goes on to discuss the number of different tastes. Castelli's dictionary approximately equates the two words, but refers to confusion. See also Chapter 9 below.
15. Roughly equivalent to dropsy.

16. Syntax precarious; "quam quum praestiterit" would be clearer.
17. The choroid plexuses.
18. Pliny, however, used the word too.
19. For an account of the history of this theory, see Otto-Joachim Grüsser, "On the History of the Ideas of Efference Copy and Reafference," in Claude Debru, ed., *Essays in the History of the Physiological Sciences* (Clio Medica 33) (Amsterdam-Atlanta, Ga.: Rodopi, 1993), pp. 35–56. Also compare Book 1, Chapter 9, original folio p. 30, of the present work.
20. *De usu partium*, Tallmadge May translation, Book 5, sec. 9, pp. 263–34, states that the tongue, eyes, ears, inner sides of the hands, and cardiac orifice of the stomach are "to a certain degree instruments of perception" in a way that the rest of the body surface is not.
21. This is Aphorism II.6.
22. This is Aphorism II.46.
23. A modern account of these appearances is by C. A. Padgham ("Measurements of the Colour Sequences in Positive Visual After-Images," *Vision Research* 8 [1968]: 939–49); he describes the sequence white › green › white › red-purple › purple › blue-purple › blue.
24. Meaning and syntax obscure; "obverto" does not normally take a direct object in this way, unless Fernel means "turns the images towards itself," as he does later on Book 6, Chapter 12, p. 141 of the original folio.
25. The meaning of this enormous sentence is not entirely clear.
26. Fernel uses this word only of bone marrow and the spinal marrow (spinal cord).
27. "Intemperantia," not synonymous with our "intemperance."
28. Syntax precarious; the effective subject is probably the mind.
29. I.e., rete mirabile and choroid plexus; the word "contextus" is applied to both in Book 1.
30. Sherrington (*Endeavour*, p. 84) traces this valve theory back to an author of the tenth century, and of course forward to Descartes.
31. Sherrington (see Introduction to the present translation) suggested that Fernel was the first to describe the central canal of the spinal cord. The cord is hollow, but nerves are not, not even large ones.
32. These two sentences represent one only in the Latin, of toppling syntax.
33. *De Memoria* 450^a12; in Richard Sorabji's rendering (*Aristotle on Memory*, London: Duckworth, 1972, p. 49): "So memory will belong to thought in virtue of an incidental association, but in its own right to the primary perceptive part."
34. The mind and intelligence, probably, although it is not clearly so.
35. It is not obvious what underlies this statement about the vents.
36. "exufflatio": this word corresponds to ἐκφύσησις, used by Galen in *De usu partium*, Book 8, Chapter 7; Tallmadge May (p. 409) translates the term as "blowing out."
37. Fernel does not appear aware that the lung occupies the whole of the cavity all the time in health. Galen was (*De usu partium*, Book 7, Chapter 9; Tallmadge May translation, p. 349): "the lung occupies all the available space in the thorax."

38. Evidently derived from the air, and not innate spirit.

39. Evidently tributaries of the pulmonary veins; see Book 1, Chapter 8, p. 23 of the original folio: "By virtue of transporting air or spirit, it is called an artery; but since this thicker air is not yet converted into vital spirit, just one coat is enough for it, and it is called the venous artery."

40. Indeed systole of the heart is related to diastole of the arteries; but J. J. Bylebyl ("Disputation and Description in the Renaissance Pulse Controversy," in Andrew Wear, R. K. French, I. M. Lonie, eds., *The Medical Renaissance of the Sixteenth Century* [Cambridge: Cambridge University Press, 1985], pp. 223–45) remarks fairly that "Fernel does not appeal to observation nor to authority: he is dogmatic. He says that the arteries dilate when the heart contracts; Riolan later simply contradicted him, using Galen's authority."

Book 7: On Human Procreation and on the Semen

The content of this book is the central theme of a thesis: Linda Allen Deer, *Academic Theories of Generation in the Renaissance: The Contemporaries and Successors of Jean Fernel (1497–1558)*. Ph.D. diss., University of London, Warburg Institute, 1980.

1. This must be not Polybius but Polybus, the Hippocratic physician who was, according to one tradition, the son-in-law of Hippocrates. For further details see the entry "Polybus (3)" in the *Oxford Classical Dictionary*, 3d ed., Oxford University Press, 2000.

2. This story is to be found in the Hippocratic treatise *Airs, Waters, Places*, sec. 22 (Loeb translation, vol. 1, p. 127). The rationale was that in Plato's *Timaeus* (77D) semen proceeding from its origin in the head was supposed to traverse the ear region on its way to the spinal marrow.

3. Not artificial insemination; the begetting happens after the man has withdrawn.

4. "separatis": this word may signify the separating out of a shaped fetus from a shapeless mass, for which the words "secerni" and "seorsum consistere" are used later in Chapters 9 and 10.

5. I cannot interpret this last clause. It happens that the next chapter in the Aristotelian source quoted here opens: "De seminis naturam dubitauerit quispiam," but if this was in Fernel's mind, he would surely have written not "naturalem" but "naturam."

6. "densis": it is surprising that some word for "cold" is not used instead.

7. There is a reference to these eggs in Chapter 1 of Book 7 also.

8. That the male is hotter is stated by Galen (*De usu partium*, Book 14, Chapter 7; Tallmadge May translation, p. 630).

9. A wealth of information on "elephas" is presented by Francis Adams in his commentary on Paulus Aegineta, Book 2, pp. 1–14; he traces the first reference to Lucretius (*De rerum natura*, Book 6, p. 1114). Castelli's dictionary specifies under the term "Elephas" a "sort of lepra or satyriasis, so named because of the skin texture."

Isidore of Seville's *Etymologiae* (Book 4, Chapter 8) refers to skin like an elephant's, or alternatively an "ingens passio" of the skin, evidently elephant-sized. Vesalius (*De fabrica*, Book 5, Chapter 9, p. 511) too refers to a skin disease, accompanied by an abnormal spleen. Both meaning and syntax are unclear here.

10. *OLD* cites Pliny and gives the meaning of "malacia" as sickness or nausea. Castelli's dictionary gives pica (perversion of appetite). From Chapter 12 it appears that Fernel is referring to pica.

11. Having seen serpents coupling, Tiresias was turned into a woman, but after seven years saw the same sight again and was turned back into a man. Hera reproached Zeus for infidelity, and his defense was that she had more joy of him in bed than he of her. Tiresias was summoned and supported Zeus's view, infuriating Hera, who blinded him. The tale is in Hyginus's Fable No. 75, written perhaps in the second century a.d. and told with lapidary brevity.

12. I cannot find this tale in Aristotle.

13. This word also means whey; but corresponds to the word used by Galen in *De usu partium*, Book 5, Chapter 5, for the "watery portion of blood" (Tallmadge May translation, p. 258).

14. Presumably the allantois, but the geometry is inconsistent here.

15. Latin equivalent of the Greek "cotyledons."

16. I do not understand the remark about the sleeping musician and have not traced any identical phrase in Aristotle, but just possibly Fernel is thinking of the sleeping geometer (*De Generatione Animalium* 735^a10) who is geometrizing in potentiality but not in actuality; when he is awake (but not actually geometrizing), he is nearer to actuality than when asleep. Mathematics and music have always been close cousins.

17. The phrase in Latin is taken from Cicero's *De Senectute* XXIII.83.

18. This is the parietal pleura; see Book 1, Chapter 8, p. 40.

19. This location in the bladder is now called the "apex."

20. The word means "related to a month" in Latin.

21. This is stated by Galen in *De usu partium*, Book 14, Chapter 6.

22. The reference is to Galen's *De naturalibus facultatibus*, Book 1, Chapter 5, and Book 2, Chapter 3 (pp. 19 and 131 in *On the Natural Faculties*, Brock translation).

23. Richard Sorabji refers in a comparable vein to Aristotle holding a "conception of the soul according to which the biological process of growth is on a level with conscious activity. Both are equally due to the soul." (*Aristotle on Memory*, London: Duckworth, 1972, p. 17.)

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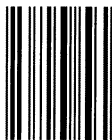
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